In Two Parts
PART ONE

January, 1935

Railway Engineering & Maintenance

NEW YEAR GREETINGS

IN the rapid development of streamlined trains operating at higher speeds, the strength of the track structure becomes of vital importance.

In the gradual development and maintenance of safer, smoother track,

RAIL ANTI-CREEPERS

are important factors.

Reliance HY-CROME *Spring Washers*

THE INTERNATIONAL LIMITED ONE OF AMERICA'S FAMOUS TRAINS

OPERATING between Montreal and Chicago, the INTERNATIONAL LIMITED, premier thoroughbred of the Canadian National Railways, sets a record in its run from Montreal to Toronto for high speed with safety in making the 334-mile leg of the route in 6 hours and 30 minutes, including stops, and the complete run to Chicago in 18 hours flat. Serving metropolitan centers along its way with fast, modern equipment, the Canadian National Railways recognizes the need for track appliances that help insure its dependable schedules. Only smooth track properly maintained will permit continued high speed with safety. For such service, HY-CROME *Spring Washers* prove their worth as dependable rail joint equipment.

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RELIANCE SPRING WASHER DIVISION

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THE PIONEER ROUND EDGE ALLOY STEEL STRAIGHT COIL SPRING WASHER

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Prove Their Economic Value

WHEREVER Lundie Tie Plates are in use—the service rendered has been conspicuously outstanding. The Lundie performs all the functions of the ideal tie plate without resorting to means which are detrimental and destructive to ties.

Lundie tie plate service is superior because:

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The plate does not slip or kick out
No tie destroying projections are needed
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It gives proper inclination to rail
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Does not cut a single tie fibre.

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It is the only essentially flat bottom tie plate that holds gauge.

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now even more economical with the new AIRCO

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Executives too, join in this strong preference for the M9 on the score of its economies . . . and of its proved dependability which means "Wheels on Rails" all the year 'round.

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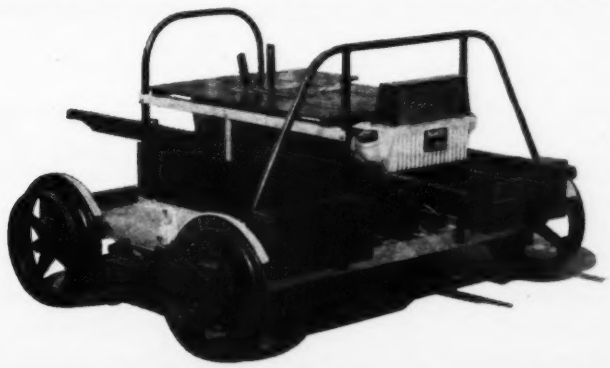

Inspection Motor Cars . . Section Motor Cars . . B & B and Extra Gang Cars . . Gas-Electric Ditchers . . Shapers . . Ballast Cleaners . . Ballast Drainage Cars . . Mowers . . Weed Burners . . . . . .

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Extinguisher Cars . . Power Cars: Air, Electric, Paint Spray, Tie Tamping . . . Rail Coaches . . Motor Car Engines . . Push Cars and Trailers . . Roller Axle Bearings . . . Wheels and Axles . . . .

ON THE UP-GRADE

Maintenance Mike Says: "It's surprising how many new faces there are in maintenance offices these days. Are you sure they know your products?"

Railway carloadings are increasing. In the first two weeks of December they were the largest, relatively, since last June.

Corresponding increases are being shown in steel production, in electric power consumption, and other indices of business activity.

This improvement is occurring at the time when the railways are formulating their plans for 1935 roadway and structures work. It will be reflected in their programs.

Yet their needs are so great that the roads cannot, even under the most favorable conditions, purchase all of the materials that they should have. Their problem is one of selection.

Are you, as a Manufacturer, telling the story of your products to those subdivision, division and system officers who are now preparing their programs for next spring and selecting the materials, tools and equipment needed therefor?

In other words, will your products be near the top of their lists?

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MAKE SERVICE CONDITIONS YOUR GUIDE

IN SELECTING CULVERTS AND DRAINS

RAILWAY engineers and operating officials agree that *service conditions vary.* That's why it is so important to choose the type of culvert or drain, which is best suited to the individual conditions and requirements of each job.

To simplify your problem, Armco offers you a "balanced drainage" plan—with a correctly designed product for each size and type of installation. 29 years of experience prove that this plan insures dependable drainage at the *lowest cost per year.* See your local Armco engineer, or write

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ARMCO'S "BALANCED DRAINAGE" PLAN

FOR PIPE UNDER TRACK

	Type of Installation	Recommended Armco Products
1	Small and medium-size openings. (8 to 60 in.)	Paved Invert Pipe
2	Bridges and Large Culverts	MULTI PLATE (Pipe or Arches)
3	Subdrains	Perforated Pipe (with Paved Invert)

FOR PIPE NOT UNDER TRACK

	Type of Installation	Recommended Armco Products
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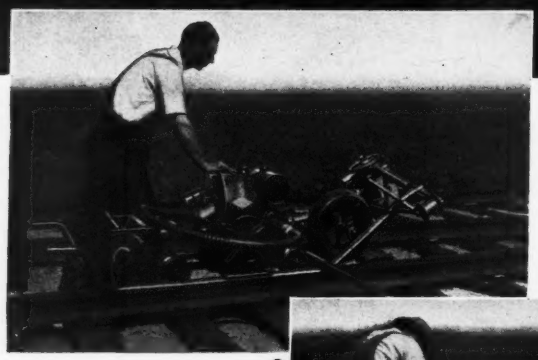
	a. Normal Conditions	Unpaved Corrugated Pipe
	b. For Steep Grades	Paved Invert Pipe
	c. Continuous Flow	Paved Invert Pipe
	d. Under High Fills	Paved Invert Pipe
	e. Diameters larger than 24 inches	Paved Invert Pipe
2	Bridges and Large Drains	MULTI PLATE (Pipe or Arches)
3	Subdrains	Perforated Pipe

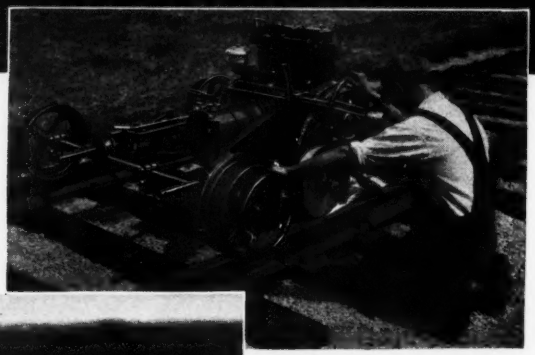
ARMCO

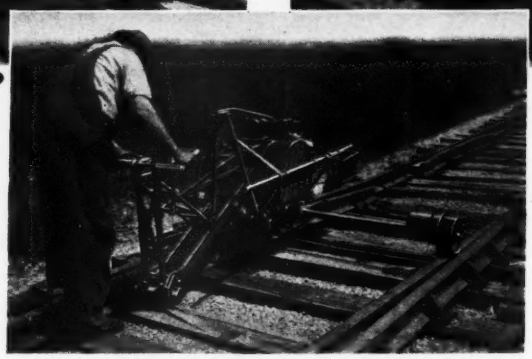
CORRECTLY DESIGNED DRAINAGE PRODUCTS
★ **for every service condition** ★

JOINTS THAT MUST BE MAINTAINED

Here are three unusual machines built for this class of work







Utility Grinder

A general purpose tool for cross cutting and beveling rail ends and for other rail and switch maintenance. Its many appliances fitting it to various jobs makes it useful at every yard and terminal.

Surface Grinder

When building up rail ends by welding, this heavy duty grinder, even on the heaviest welds, will produce the smoothest joints in the least time. It is sturdily built and its operation is simple.

Track Wrench

For regular joint maintenance and when laying rail, this tool will enable joints to be easily made uniformly tight, and quickly and at a less expense too.

The tools shown above and used for the maintenance of joints, are only three of the eight machines which Nordberg has developed for the maintenance of track. With these various tools, it is possible to simplify track work and to secure better track at less expense.

Besides for joint maintenance and the care of switches, frogs, etc., they have become standard equipment for rail relaying, ballasting, yard construction and similar jobs.

When planning your next year's track program, investigate the merits of these machines and how they can serve your road to advantage.

Put These Nordberg Tools To Work On Your Track Jobs

UTILITY GRINDER
SURFACE GRINDER
TRACK WRENCH
ADZING MACHINE
SPIKE PULLER
POWER JACK
RAIL DRILL
TRACK SHIFTER

NORDBERG MFG. CO. MILWAUKEE WISCONSIN

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WHEN you lay new rail, prolong its life by heat-treating every rail end, the new and dependable method of defense from rail end batter.

When you decide to repair track, the Oxweld techniques for building-up rail ends, frogs, switch points, and crossings by the oxy-acetylene process furnish effective procedures for increasing efficiency by economical means. Oxweld contract roads should avail themselves of these most modern applications of the oxy-acetylene process,—developed exclusively for them by The Oxweld Railroad Service Company.

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No. 73 of a series

Railway
Engineering and Maintenance

SIMMONS-BOARDMAN PUBLISHING COMPANY

105 WEST ADAMS ST.
CHICAGO, ILL.

Subject: A New Dress

December 27, 1934.

Dear Reader:

With the start of a new volume (No. 31) we are bringing Railway Engineering and Maintenance to you in a new dress. As you will note, we have changed the typography materially. In taking this action we have been prompted by several considerations.

In the first place, we believe that one evidence of youth and virility is the ability to change one's habits or practices and we want to be sure that we retain those characteristics. Again, styles change in typography as in clothes and we want your magazine to be as strictly up-to-the-minute in appearance as it is in editorial contents. Even more important, we hope through these changes to make Railway Engineering and Maintenance the most attractive in appearance and the easiest for you to read of any magazine that comes to your attention.

The first and most striking change that you will note is the transition, for other than the editorials, from a two-column to a three-column page. This change reduces the length of the line from 20½ picas (3⅜ inches) to 13½ picas (2¼ inches). It recognizes the findings of exhaustive studies made at Columbia University and elsewhere in which it was determined that the 13½ pica line resulted in minimum fatigue of the muscles of the eye.

Second in importance among the changes is that from the Kabel type face for headings to the newer and equally masculine face known as Karnak. When we adopted the Kabel face three years ago, we were in the vanguard of a trend towards bolder san-serif type. More recently, the Karnak face has been developed, retaining the strength characteristic of two-fisted men of action but with a return to the serif to promote ease of reading.

Elsewhere you will find other changes—new department heads, the elimination of initial letters at the beginning of articles, a new design for running head, larger heads over items in the news department, etc.—all designed to produce for you a more distinctive and attractive magazine and one that you will read more easily.

We hope that you will like these changes. We shall be pleased to learn your reaction.

Yours sincerely,

Elmer T. Howson

ETH:EW

Editor.

MEMBERS: AUDIT BUREAU OF CIRCULATIONS AND ASSOCIATED BUSINESS PAPERS, INC.

● *Photograph showing diagrammatically the manner in which the steel bearing piles are encased in concrete.*

THREE-PILE BENTS

with these steel bearing piles *speed up bridge construction*

● Three-pile bents, using steel bearing piles, reduced the cost and expedited the building of this Missouri Pacific Railroad Company bridge at Wichita, Kansas. With this type of construction, it was unnecessary to remove portions of the old structure in driving the new piles. This permitted utilization of working time to the fullest extent.

For hard driving or in locations where substantial bottoms are difficult to reach, CB SECTIONS as bearing piles provide a sound and economical foundation. The ease with which they can be driven means usually a definite saving in construction time and cost. In the bridge here illustrated the piles were driven through 35 to 40 feet of sand to reach firm shale. Jetting was unnecessary and no difficulties in driving were encountered. Additional information on the use of steel bearing piles in both railway and highway bridges may be had upon request.

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STEEL BEARING PILES

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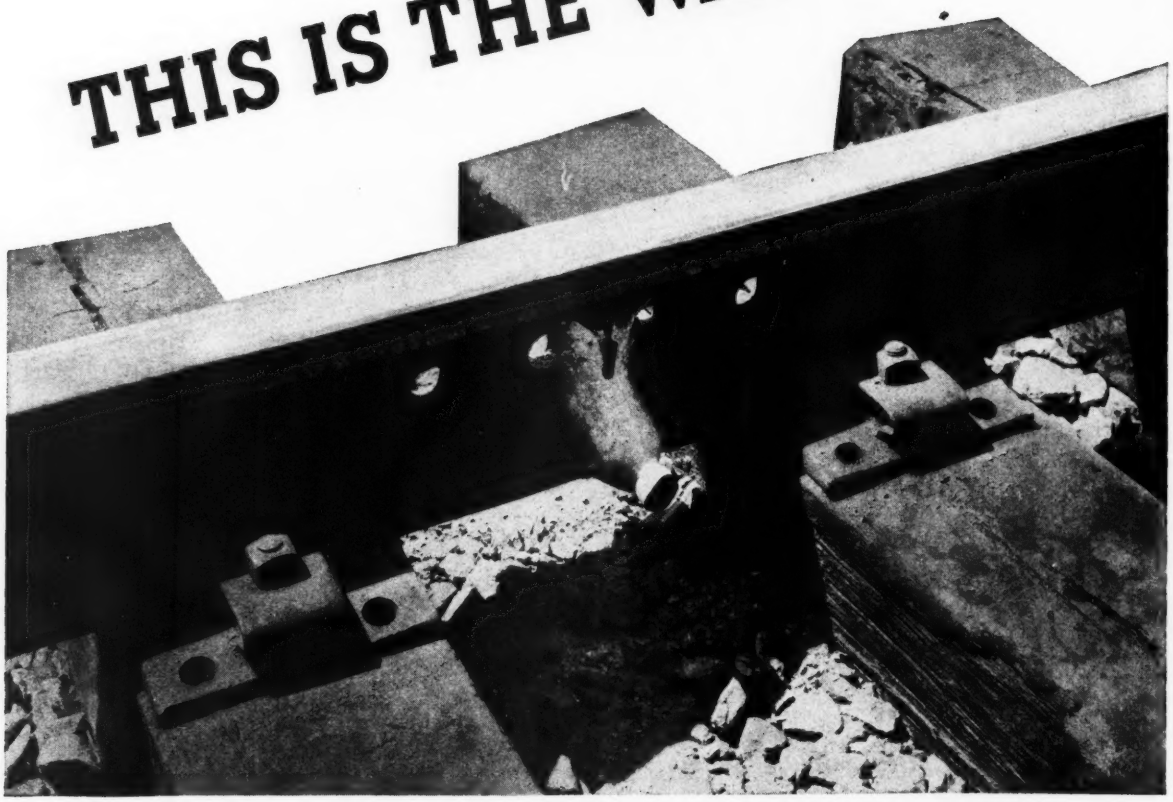
THIS IS THE WAY



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Continuous rail...rail in long stretches, unbroken by troublesome joints...is no longer a remote ideal. It is now an accomplished fact, made possible by Thermit Pressure Rail Welding.

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The Thermit Pressure Rail Weld, developed especially for railroad use, combines a pressure butt weld of the head of the rails with a perfect fusion weld of the base and web. This weld can be installed by your own track forces at a cost comparable with that of a bolted joint. And, with Thermit Rail Welding, the first cost is the last.

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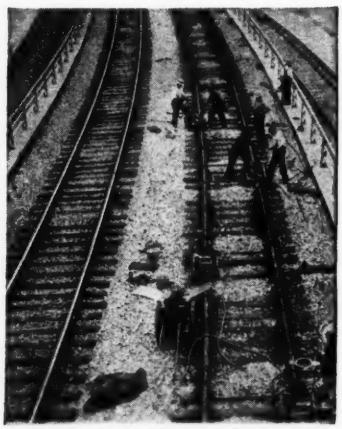

Thermit Rail Welding on the Delaware & Hudson Railroad at Albany, N. Y.

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Railway Engineering and Maintenance

NAME REGISTERED U. S. PATENT OFFICE

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STYLE NO. 100-A

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RAILROAD SPECIAL TRACK
EQUIPMENT MANUFACTURING

After severe tests at such locations, many of the leading roads have now adopted the 3-in-1 switch stand as standard. None of the claims we have made for this stand were disproved during these tests. The 3-in-1 was especially designed for use at the ends of double track and passing siding. Its three features, all combined in one compact housing, are:

1. A rigid-throw always ready for hand operation.
2. Two automatic double-coil springs returning points after trailing train has passed.
3. An oil-buffer preventing return of points between successive pairs of wheels.

This is the first switch stand to combine all these features in one compact housing; in throwing it *cannot* be closed and locked when an object intervenes between the points and the stock rail. Many locations on your railroad need this switch stand. Write today for complete printed information about the 3-in-1.

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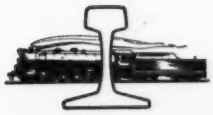
Railway Engineering and Maintenance



1934-1935

A Review of the Past; a Glimpse Into the Future

THE year that has just closed was one of mixed trends in engineering and maintenance of way activities. It was another year of subnormal maintenance, marked by failure to hold in the last half of the year, gains recorded in the opening months. As a result, the accumulation of deferred maintenance has increased for the fifth consecutive year and the properties as a whole are in poorer condition than a year ago. Yet 1934 was a year of somewhat more liberal programs than 1933 and as a result the deterioration of the properties, while not entirely arrested, was reduced markedly, an indication that the force of the depression has been spent and that we are now definitely launched on the upward path of recovery.

The year was noteworthy also as witnessing the beginning of a new era in faster transportation by rail, with speeds, especially in passenger service, materially in excess of those prevailing heretofore. Such schedules require a refinement in track maintenance not heretofore warranted and will lead to many modifications of present practices as they become more general. All told, the year was more important for what it forecasted than for its actual accomplishments.

The Year's Record

The record made during the year may be summarized briefly as follows:

Freight traffic increased about 8 per cent. In 1933 it increased 7 per cent, reversing a decline that began in 1930.

Passenger traffic increased 13 per cent, reversing a downward trend that had continued without a break since 1923. In 1933 it declined 4 per cent.

Gross operating revenues were approximately 6 per cent larger than in 1933, arresting another downward trend that had continued since 1929. They declined 1 per cent in 1933.

Operating expenses increased about 9 per cent, as contrasted with a decline of 7 per cent in 1933, reversing another trend that had prevailed since 1929.

Net railway operating income declined approximately 4 per cent, as compared with an increase of 46 per cent the previous year. However, it exceeded that for 1932 by more than $125,000,000.

The roads as a whole fell short of earning their fixed charges in 1934 by $15,000,000 to $20,000,000. The deficiency the previous year was $5,863,000.

The rate of return earned on property investment approximated 1.7 per cent, as compared with 1.8 per cent in 1933.

Such figures indicate the difficulties confronting railway managements in the period through which we are passing. Even more striking are the figures by months. Starting with May, 1933, operating revenues increased, in comparison with the corresponding months of the previous year, in every month but two until July, 1934. Beginning with that month, however, renewed anxiety regarding national administration policies caused business to become more cautious, and traffic declined to levels below those of the previous year. In the closing weeks of the year the trend was again reversed and it ended with operating revenues approximating those of a year ago.

This decline in traffic, combined with increases in expenses brought about by the partial restoration of the wage reduction initiated early in 1932 and the deductions for pensions during the latter months of the year, served to reduce net railway operating income for these months below that for the corresponding period of the previous year. As a result, expenditures for maintenance activities were curtailed more than seasonally, although the total for the year exceeded that for 1933 by approximately 13 per cent.

Expenditures for Maintenance

The expenditures for recent years were as follows:

Expenditures for Maintenance of Way and Structures

1917	$ 442,109,862	1926	$ 866,819,365
1918	649,794,953	1927	868,581,432
1919	772,186,045	1928	837,905,747
1920	1,032,540,381	1929	855,354,867
1921	756,413,690	1930	705,470,940
1922	728,663,534	1931	530,612,890
1923	813,688,760	1932	351,179,041
1924	792,678,023	1933	322,335,022
1925	816,443,205	1934*	360,000,000

*Last two months estimated.

The significant feature of these figures is the change in the trend from that which prevailed since 1929. In 1930 expenditures for maintenance of way were 18 per cent less than in 1929; in 1931 they declined 25 per cent from 1930; in 1932 they were 34 per cent below those for 1931 and in 1933 they were 9 per cent less than in 1932. In the year that has just closed, however, the decline was arrested and an increase of 13 per cent recorded. It is significant also to note that this change in trend occurred in the summer of 1933, with the result that the expenditures in every month since that time have exceeded those for the corresponding month of the preceding year except in November, 1933, and

September, 1934, when there were slight recessions. It is pertinent also to note that the spread has been decreasing steadily since last May until the expenditures during the closing months of 1934 approximated those of the previous year. If the improvement in traffic which appeared in November is sustained, it is to be expected that the upward trend in maintenance expenditures will soon be resumed.

Trend of Maintenance Expenditures by Months

	1932 (000 omitted)	1933	Per Cent Change	1933 (000 omitted)	1934	Per Cent Change
Jan.	$29,970	$22,655	—25	$22,655	$25,159	+11
Feb.	28,466	21,596	—25	21,596	25,122	+17
Mar.	30,760	22,592	—28	22,592	28,508	+26
Apr.	32,505	24,440	—25	24,440	30,133	+23
May	33,951	27,323	—20	27,323	35,049	+28
June	32,713	28,805	—12	28,805	35,612	+23
July	29,449	30,401	+2	30,401	34,355	+13
Aug.	28,990	32,769	+10	32,769	34,196	+4
Sept.	28,059	31,597	+11	31,597	31,501	—.03
Oct.	28,972	30,961	+7	30,961	32,627	+5
Nov.	26,233	26,071	—.06	26,071		
Dec.	21,365	23,040	+8	23,040		

One influence that stimulated maintenance work early in the year was the loaning of $199,607,800 to 31 roads by the Federal Public Works Administration, approximately $50,000,000 of which went for roadway purposes. These loans were made to assist the roads in financing needed work and also to stimulate employment directly by the railways and indirectly in the mills and factories through orders for materials, especially rails and fastenings. By means of these loans, it is estimated that more than 100,000 persons were given employment, including 35,000 maintenance men.

The Accumulated Deficiency

Second in importance only to the change in trend of these annual expenditures is the accumulated deficiency. In the five years 1925-29, the railways spent an average of $849,021,000 for maintenance of way. In the five years beginning with 1930, their expenditures have fallen short of this amount almost two billion dollars. After giving full recognition to the reduced wear and tear resulting from the smaller traffic, the decreased charges coming from the almost complete cessation of construction activities, the increased return secured per dollar of expenditure for both labor and material, and other factors, we estimated a year ago that the railways would have to spend at least $700,000,000 to restore their properties to the condition that prevailed in 1929. While a somewhat larger amount was spent for maintenance last year than in the preceding year, this increase has not been sufficient to compensate for the deterioration of the year itself, with the result that the $700,000,000 estimate of deferred maintenance of a year ago is increasingly conservative now.

Turning to employees, we find the same trends as in expenditures. During the four years 1926-29, the annual force averaged 412,777, with fluctuations ranging from a maximum of 487,000 in the summer to 330,000 in the winter. In 1930, this annual average declined to 349,202; in 1931 to 275,486; in 1932 to 215,887 and in 1933 to 198,038. In 1934, however, the average approximated 208,000, with the total for each of the first eight months exceeding that for the same month of 1933, since which time small decreases have occurred. Even in these latter months, however, the number employed in 1934 have exceeded that for the same months of 1932. It is of interest to note that for the fourth consecutive year the maximum force in any month has been less than the normal winter force prior to 1930.

The manner in which the roadway and structures have met the steadily more exacting demands of traffic is a tribute to the judgment displayed by maintenance officers in their distribution of the limited funds and forces available. It is equally a vindication of the policy pursued by the managements in the years prior to 1930, when funds were available, of plowing into the properties a reserve of strength, for it is this reserve which has carried them through this period of undermaintenance. While the results to date have exceeded all expectations, it is difficult to determine how much further this policy can be continued with safety.

It is self-evident that every train that passes over the tracks and structures exacts a toll in service life therefrom which, if not replaced in due time, results in a weakening of the structure. Likewise, decay and the elements exact their toll with the passing of the days. To the extent that this deterioration is not made good, the property suffers. From figures presented above, it is evident that there is now a deficiency in upkeep totaling well over a year's normal maintenance, after making full allowance for the reduced wear and tear resulting from a lighter traffic and the lessened destruction of the elements brought about by the subnormal rainfall of the last two years in many portions of the country. In many details such as painting, the deficiency is much greater, for maintenance officers have of necessity concentrated on those operations that contributed most directly to safety of travel, to the neglect of those other activities which, while important, can be postponed for a time without grave consequences.

The Rail Situation

Outstanding among the evidences of deferred maintenance is the marked reduction in the amount of rail relaid during the last few years. This is shown in the following figures:

	New Rails Laid In Replacement		New Rails Laid In Replacement
1923	1,660,000	1929	1,958,489
1924	1,720,000	1930	1,517,002
1925	1,870,000	1931	984,900
1926	2,120,000	1932	394,536
1927	2,124,765	1933	403,254
1928	2,080,277	1934 (estimated)	600,000

An analysis of these figures indicates that it will require the laying of at least 3,500,000 tons of rails to obtain a condition of track equivalent to that which prevailed in 1929.

Offsetting this deficiency in part has been the marked increase in the application of methods for extending the service life of the rails now in use. This has been evidenced by the marked expansion during the last year of the practice of building up battered rail ends and worn rail joints. Closely allied with this has been the growing practice of heat-treating the ends of new rails as they are laid in track to increase their resistance to batter. Contributing also to increased service life of rail is the more extensive use of transverse fissure detector equipment to free from suspicion rails from heats in which fissures have been detected

while at the same time eliminating rails that have developed defects. Encouraging progress has also been made during the year by certain of the rail mills in the development of means for eliminating the conditions conducive to the formation of these fissures.

Tie Renewals

Another measure of the degree of undermaintenance is afforded by the crosstie renewals. Here traffic, while a factor of increasing importance with the lengthening of tie life as a result of treatment, is of less direct influence than with rail, for ties still fail largely through decay and this continues regardless of traffic. However, the influence of treatment was shown by the steady decline in renewals in the prosperous years prior to 1930. Yet, after making full allowance for this trend and also for the lessened mechanical destruction resulting from the decline in traffic, it is estimated that there are in track today more than 85,000,000 ties that would have been replaced under more normal conditions. This deficiency has been increased by at least 10,000,000 ties during the year just closed.

A particularly disturbing feature of the tie situation has been the increasing trend during the last two years towards the use of untreated ties as a temporary means of securing maximum tie support from available funds.

Crossties Applied in Renewals

Date	All	Treated	Per Cent of Treated Ties
1920	86,829,307		
1921	86,521,556		
1922	86,641,834		
1923	84,434,985		
1924	83,073,059		
1925	82,716,674		
1926	80,745,509	55,557,706	68.8
1927	78,340,182	57,082,993	73.0
1928	77,370,491	59,157,540	75.5
1929	74,679,375	59,047,380	79.1
1930	63,353,828	49,720,080	78.5
1931	51,501,659	39,827,791	77.3
1932	39,190,213	29,435,055	75.2
1933	37,295,716	26,339,516	70.8
1934	45,000,000 *(Estimated)*		

The effect of this long continued and drastic undermaintenance is becoming a matter of grave concern. To date no serious difficulties have developed; yet it is becoming increasingly apparent that there must be a day of reckoning. Whether this is approaching cannot yet be determined. However, one indication is afforded by a study of the derailments due to roadway defects. The number of such derailments per billion locomotive miles showed a continued and unbroken decline until the middle of 1933, since which time the trend has been reversed and the last year shows an increase of more than 10 per cent. While this change is not yet sufficiently pronounced to warrant definite conclusions, it justifies serious attention.

High Speed Trains

The outstanding development of the year, measured both by its importance to the railway industry and by its effect on the roadway department, has been the introduction of a new and much faster passenger service. Starting with the demonstration runs of the Burlington Zephyr and the Union Pacific streamlined trains between Denver and Chicago last May and between Los Angeles and Chicago last October, with average sustained speeds of 78 and 59 miles per hour, respectively, for the entire distance between terminals, plans are now being made on a number of roads for schedules requiring operation between terminals at speeds ranging up to 75 to 90 miles per hour. These schedules are being planned for trains of light weight construction propelled by Diesel power and also for trains of standard construction drawn by steam locomotives. Such schedules are introducing new problems for the track department, requiring a refinement of line and surface, especially on curves, that has not heretofore been required or warranted.

Nor is this trend towards higher speeds confined to passenger service, for the last year has also witnessed a marked tendency to shorten freight schedules as well. This is illustrated by the action of the Chicago-St. Paul roads last fall in initiating an 11-hr. schedule between those points, necessitating the running of these trains at *average* speeds between terminals of 40 to 45 miles per hour. Such speeds are placing an added burden on the track that makes it all the more difficult to maintain the exacting riding conditions demanded by the new passenger schedules.

From the standpoint of organization, the last year witnessed a continued trend towards specialization, with the transfer of more work from section to specially organized floating gangs. While such operations as rail laying and ballasting have long been recognized as being done best by special gangs, this principle is now spreading to tie renewals. One large system which first tried this plan two or three years ago, now follows it as standard practice, while another large road which tried it on a limited mileage in 1933, extended it over the system in 1934. Similarly, the practice of assigning the tightening of bolts to special gangs who work over a line out of face made appreciable progress during the year. In all such work, the economy arises primarily from the ability to make more efficient use of power equipment designed for the task in hand. As a result, power equipment became more strongly entrenched during the last year.

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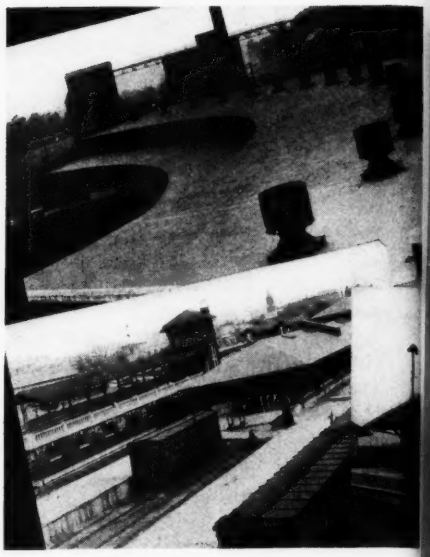
The New Year

As to the new year, the developments of the last year indicate that definite ground has been gained in the battle against the depression. While the rate of progress slackened somewhat in the late summer and fall, traffic again picked up in the closing weeks of the year, indicating the beginning of another forward movement. There are many evidences that the depression has now spent itself if other untoward influences do not develop.

With railway managements showing a more aggressive attitude in meeting competition and a greater willingness to introduce new services, and with the public appreciating more fully the necessity for equalizing this competition by eliminating subsidies now given competing carriers, it would appear that the railways are now on the verge of an upturn in traffic that will not only require higher standards of maintenance than ever before provided, but will also provide the funds necessary for such improvements. Maintenance of way men enter the new year, therefore, with a more encouraging outlook than they have faced at any time during the last five years.

Roofs

Practical Considerations in their Application and Repair



IN the belief that marked improvement could be made in the application and maintenance of roofing by unifying the practices on the various portions of its system, the Northern Pacific has prepared a manual of roofing practices for the guidance of its building forces. This manual represents what is believed to be the first attempt ever made to provide a comprehensive guide covering all phases of the application and maintenance of the various types of roofing in common use.

In making a survey of its maintenance practices, this road found considerable variation in the roofing methods followed by different divisions. This study also disclosed that no general instruction or information on roofing practices had heretofore been issued, which might serve as a guide for the division forces in maintaining roofing. It was decided, therefore, to place these practices on a unified basis.

Roofing Literature Scarce

When the preparation of the instructions was undertaken, search was made through maintenance and other engineering literature to insure that the best practices for each type of roofing would be included. Much to the surprise of the officers who were interested, this search produced practically nothing of value for their purpose. They did find a relatively few scattered bits of information but nothing comprehensive enough in character to be useful. Inquiry was also made of several other roads having high standards of maintenance, with regard to the instructions they issue with respect to the maintenance of roofs, but this inquiry also proved to be unfruitful.

This threw the road back entirely on its own resources and caused it to change in some respects the plan as it had originally been conceived. It had been the intention originally merely to issue rules that were sufficiently complete to insure that local differences in practices would be eliminated and the practices co-ordinated for the system as a whole. As the matter was studied further, it became clear that, to be of maximum value, the plan should be expanded to include the characteristics of the various roofing materials and explanatory matter concerning certain of the practices that were to be followed.

In preparing the manual, the objective has, therefore, been to present the best practice consistent with practical considerations for each type of roof. In compiling the instructions, however, two things were recognized. The first was that in many instances, divergent practices are followed by different roads, each having some distinctive merit. The other was that there may be wide variation even on individual roads in the service conditions which surround the application and maintenance of roofing, depending on the type of building, its location and use and the climatic conditions of the locality. Because of this diversity, it is stated explicitly in the foreword of the manual that although the instructions have been issued in the expectation that they will be followed generally and that the practices will thus be unified for the system as a whole, they are not intended to be taken as rigidly fixed standards of procedure but shall be followed so far as consistent and departed from for good reasons only.

Northern Pacific, finding no comprehensive literature, drafts manual to meet its conditions. The instructions which have been prepared for the guidance of its building forces cover materials, methods of application and maintenance.

Two exceptions to this flexibility were made, the first being with respect to the quality of the materials that are to be employed and the other a requirement that all applications of roofing to new buildings shall be in accordance with the standards of the road for new application or with special plans that may be prepared for certain structures.

If consistent and satisfactory results are desired, the quality of the roofing materials should be not only dependable but uniform for the system. In other words, if the door is left open for local officers to order materials differing in quality from those used on other divisions, there can be no co-ordination of the roofing practices. It should be understood, however, that the specifications as drawn do not stipulate brands, so that the way is left open for any manufacturer who can meet the requirements of the specifications. This requirement of the manual does not, therefore, restrict the local officers in any degree in their choice of materials so long as they conform to the stipulation as to quality.

The exception with respect to new applications was made for the reason that while the manual covers in detail the various steps for applying the roofing materials most commonly used, occasional buildings are constructed of special design or having special roofing requirements for architectural purposes which cannot be covered by the general instructions in the manual. In view of this possibility, it was considered desirable to include a provision in the manual which would call attention to these special cases.

As an indication of the scope of the manual, the instructions cover ma-

terials, methods of application and maintenance of asbestos and asphalt shingles, prepared roofing and built-up roofing of both tar and asphalt. Sections covering each of these materials are divided to permit detailed instructions for each of the conditions of application. For example, there is a general chapter on built-up roofing, followed by a more detailed discussion of pitch and gravel roofs, after which instructions are given separately for four-ply and five-ply construction directly over the roof decks and for four-ply construction with insulation. The same plan is used for all of the other materials. The final chapter in each case consists of instructions in the proper method of maintenance of each of the various materials.

Other Types

Instructions governing tile, slate and metal roofing are not included, the reason for this omission, in the case of tile and slate roofs, being as follows:

Tile roofs, such as are now in service on a number of depots, shall be maintained as long as it is economically possible to obtain tile of the same design for repairs. If it is found that proper tile can no longer be obtained, it may be feasible to remove the tile from a part of the roof, replacing it with the nearest duplicate obtainable and use for repair that which is removed.

Slate roofs, such as are still on many old shop buildings, can generally be kept in service for the life of the building by replacing individual shingles with shingles made of galvanized sheet metal painted black. Ultimate failure of the roofing may result from disintegration of the slate by the action of the elements, but quite often failure is due to decay of the wood roof deck and of the shingle nails.

Metal roofing is not used generally by this road and because each class of material requires a different method of application, it was considered undesirable to burden the manual with instructions that would be used only occasionally. Furthermore, to obtain architectural effect the designs of metal roofs may also vary to the extent that special instructions will be necessary, thus decreasing the desirability of including this type. It was also considered that the methods to be followed in the application of wood shingles were so generally understood that it would be unnecessary to include instructions pertaining to them.

One of the arresting features of the manual is that in large part it is written in a form that can be designated as "specification-instructions." In other words, it does not comprise merely a set of rules. Although it stipulates what practices are to be followed, materials and their characteristics are discussed and reasons are given for many of the requirements that are laid down. In this way, the reader is given a clear idea why these rules are considered necessary.

New Shingles Over Old Ones

Owing to the abundant supply of forest products along its lines, the Northern Pacific has an unusually large number of buildings with wood-shingle roofs. In general, wood shingles on buildings located adjacent to operated tracks are not considered as desirable as those of more fire-resistant types. Where wood-shingle roofs require renewal and either asbestos or asphalt shingles are to be used for replacement, the manual provides that they shall be applied over the old wood shingles. As an example of the manner in which methods are discussed in the manual and reasons are given why certain practices are preferred, the following extract is of more than ordinary interest:

With few exceptions, asbestos or asphalt shingles can be applied over old wood shingles and this shall be done where practicable. Some believe that this procedure is not good practice and in theory this may be true, but it is not supported by facts, since about 85 per cent of re-roofing work is done in this manner. The economic advantages of the practice, such as the saving in cost of removing the old shingles and, in most cases where they are laid on open decks, of filling the open spaces in the sheathing; the cost of applying saturated felt under the new shingles; and the insulating value of the old roofing, considerably outweigh the advantages claimed by those who advocate the removal of the old shingles. It is necessary, of course, that the application of the new shingles be made properly, but this requirement will apply in any case.

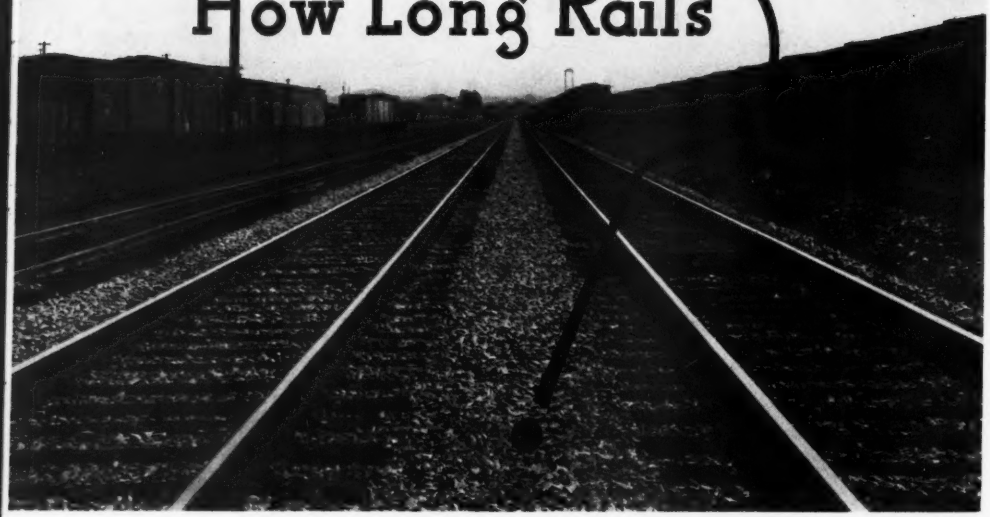
How Roofing is Selected

Certain types of roofing are adapted especially for particular types of buildings. On the Northern Pacific it is customary to apply asbestos shingles on main line passenger or combination stations in the more important communities, provided there is little prospect that they will be replaced within the normal life of the roof. In general, asphalt shingles are used on less important combination depots on main and branch lines and on section houses, signal maintainers' cottages, interlocking towers and other buildings of similar importance or character. Prepared roofing is used on buildings of less importance. Wood shingles may be used on buildings not immediately adjacent to operated tracks.

Built-up roofs of various types are generally applied to buildings of large area, such as shops, enginehouses, power plants, freight houses and other buildings of permanent character, where advantage can be taken of the economy that results from the long life that is characteristic of these roofs.

In the manual, the specification-instructions for the application and maintenance of each particular class of roofing are preceded by a chapter in which the general requirements for that class of roofing and the materials to be used are discussed. These discussions, together with the specification-instructions for the various roofing materials included in the manual will be given in a series of articles, of which this is the first. The second will include the application of asbestos shingles.

How Long Rails



The Main Line Installation at Mechanicville, N.Y., Involves a Total of 254 Joint Welds and Continuous Rail Length of Approximately 2,000 Ft.

Delaware & Hudson develops many interesting facts in two installations involving continuous lengths up to 2700 ft.

THE Delaware & Hudson has made two sizable installations of welded rails in ballasted track, which are disclosing a number of interesting facts that have not heretofore been established or accepted generally, in this country at least, and which, incidentally, are said to be resulting in improved track conditions with materially reduced maintenance. These installations, one of which involves unbroken rail lengths of approximately 2,700 ft., and the other of approximately 2,000 ft., are both in otherwise standard main-line track of the road, and were effected by joining the ends of standard 39-ft. rails by means of Thermit pressure welds. Neither of the installations has been affected adversely in alinement and surface through a wide range of temperature change, but, on the contrary, both installations have stood up unusually well under traffic, with considerably less than the usual amount of attention. Altogether, 565 joint welds are included in the two installations.

The Delaware & Hudson made its first installation of welded track in August, 1933, following a rather extended investigation of the action of long rails in open track in this country and in Europe, particularly as regards the joint welds and the control of expansion and contraction. This installation was made in the main tracks of the road directly back of its general office building at Albany, N. Y., where it could be kept under close observation.

Extends Over 3000 Ft.

The weld construction in both the north and southbound tracks extends over a distance of more than 3,000 ft., but, owing to the presence of turnouts in both tracks, the longest continuous stretch of welded construction in the southbound track is approximately 1900 ft., including 53 successive welds, and in the northbound track is approximately 2,700 ft., including 68 successive welds. At the point of this installation, the track alinement is quite irregular, including consecutively, from south to north, a 5-deg. curve to the right, two short 4-deg. curves to the left and a 7½-deg. curve to the right, with the different curves connected by relatively short stretches of tangent track. Incidentally also, a considerable length of the track involved in this installation is on a grade that reaches a maximum of one per cent ascending to the south.

The second installation of welded track was made in May, 1934, at Mechanicville, N. Y., where both rails in both main line tracks were made continuous for a distance of approximately 2,000 ft., involving a total of 254 welded joints. Throughout this installation the tracks are straight and on a grade which averages 0.25 northbound.

In both the Albany and the Mechanicville installations, the type of track construction employed, other than the welded joints, is the main line standard of the road, and, therefore, essentially the same. This includes from 14 to 18 in. of crushed stone ballast beneath the ties, sound treated red oak ties, large double-shoulder canted and cambered tie plates lagged to the ties independently of the rail, and two spring clips at each plate holding the rail in position independent of the tie plate fastening. Thirty-nine-foot rails were welded together in both installations, the only difference in this regard being that 130-lb. R.E. rail was laid in the Albany installation, while rail of the new A.R.E.A. 131-lb. section was laid at Mechanicville.

Thermit pressure welds were used to join the rails together in both installations, and the details involved in making the welds were practically the same, except that certain refinements in methods, organization and

equipment were embodied in the second installation as a result of the experience gained in the first. Briefly, the Thermit pressure weld employed is a combination of a Thermit fusion weld and a pressure weld, the two being effected simultaneously. In the joining of rail ends, the Thermit fusion weld is confined to the bases and the lower half of the webs of the two rails, while the rail heads and the upper half of the webs are joined by a pressure weld. To effect this combination weld, the ends of the rails to be joined are cut on a bevel, from the top, backward into the rail a distance of 1/16 in. at the base. Furthermore, the lower half of the web and the entire base of each rail are cut back about ¼ in., to provide ample space for the entrance and fusion of the Thermit metal with the rail metal.

Work Done in Field

All of the work of preparing the rail ends for the installation at Albany was done in the field, the bevel and facing at the top being effected with a facing machine, and the larger cut at the bottom being made with an acetylene torch. In the Mechanicville installation, the rail was beveled and faced at the mill, leaving only the acetylene cutting of the lower half of the section to be done in the field.

In making both of the installations, the specific track being welded was taken out of service during the progress of the work, this being necessary primarily because of the character of the equipment employed and the time required in the preheating operation. However, in making the Albany installation, new rails already in the track were unbolted and then welded, while at Mechanicville, the new rails were welded together while blocked up on the ties immediately alongside the older running rails.

While the procedure followed in making the welds at both installations was essentially the same, the work at Mechanicville was done with improved equipment and a better organization of forces, which permitted the welding operations to continue at two adjacent joints at the same time. As a result, the average total cost of each welded joint in place in the track in the Mechanicville installation was only approximately $8, whereas the average cost of each joint in the Albany installation was considerably in excess of this figure.

Because of the lack of precedent in the action of long continuous rails in standard ballasted track in this country, one of the major factors of interest in the Delaware & Hudson installations has been that of expansion and contraction under a wide range of temperature. A second factor has been that of the strength and reliability of the welds.

Effect of Temperature

At the time the Albany installation was made, it was calculated that with a temperature range of 150 deg., which is not considered improbable in that section, the continuous 2700-ft. lengths of rail in the northbound track would, under unrestrained conditions, effect a change in length of approximately 2 ft. 8 in. Just what the change in length might be under the restraining influences of the track fastenings, particularly the double-shoulder tie plates and the spring rail clips employed in the D. & H. construction, was a matter of conjecture but it was felt quite confidently that it would be only a relatively small proportion of the change that would occur under unrestrained conditions.

However, to be prepared for the worst possible condition, a special expansion joint was designed and installed 280 ft. from one end of one of the 1900-ft. lengths of rail in the southbound track, which is capable of absorbing the maximum change in length considered possible in this long rail, or, 1 ft. 10 in. Similar joints were planned for the other three long rails in the Albany installation, but before they were built, experience indicated definitely that they would not be required.

The long rails at Albany were welded together during the daytime when the temperature of the rail averaged well above 125 deg., and the final closure of the rails in the track was made when the rail temperature was above 130 deg. Some days after the completion of the work when the rail temperature was considerably below 130 deg., one of the rails in the southbound track was cut to insert the special expansion joint. To the surprise of those carrying out the work, there was no perceptible movement of the long rail, and the joint was placed in position without difficulty. Furthermore, to the present time there has been practically no movement of the rail through the expansion joint, in spite of the fact that the rail in the track, according to actual thermometer readings, has reached temperatures far below zero and in excess of 130 deg.

The sizes of the joint openings at the opposite ends of the long rails in the northbound track at Albany, for a wide range of rail temperatures, are shown in the accompanying table. The openings at the extremes of temperature as shown in this table are pointed out as follows: On Dec. 29, 1933, when the temperature of the east rail was 5 deg., the joint opening at the north end was 5/16 in. and at the south end was ⅜ in., whereas on June 11 of the present year, when

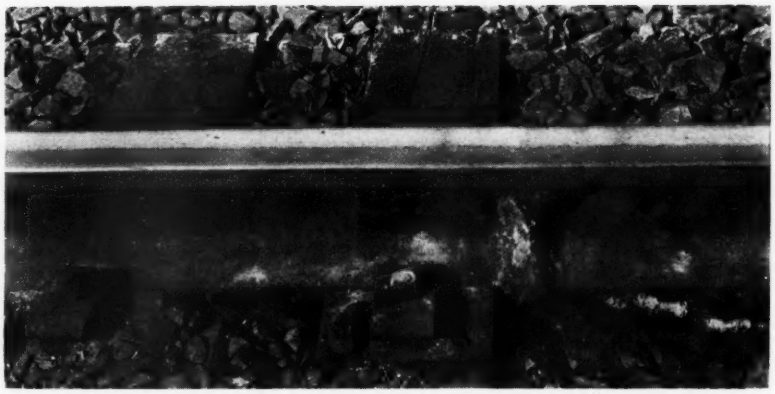
Drawing Off the Thermit Metal Into the Molds to Form the Lower Part of the Joint Weld.

the same rail had a temperature of 95 deg., the openings at the same joints were 0 and $\frac{5}{16}$ in., respectively. Similarly, considering the west rail, the north and south end joint openings on December 28, 1933, were $\frac{5}{16}$ and ½ in., respectively, while the openings at the same joints on June 11, 1934, were 0 and ¼ in. Between the extremes of temperature recorded, the maximum change in size of any of the joint openings was $\frac{5}{16}$ in., and that occurred at two joints which had a maximum opening of this amount when the rail registered a temperature of 5 deg.

The ability demonstrated to control expansion and contraction in the rail through a wide range of temperature is attributed to the type of track construction employed, and, particularly, to the spring rail clips and double-shoulder tie plates used, the former setting up a resistance to longitudinal movement of the rail of 4,000 to 5,000 lb. at each plate. This resistance, combined with the binding action of the double-shoulder plates on the base of the rail, is obviously the restraining force against the normal longitudinal movement of the rail with changes in temperature.

Holds Line Well

While remaining practically fixed in length, the track has also remained practically fixed in alinement. To ascertain any lateral movement which might occur, five fixed measuring points were established at the installation at Albany, on curves as well as on tangents. At these points, saw cuts in steel fence posts on opposite sides of the two welded tracks permitted stretching piano wire between the posts and thus re-establishing at will fixed base lines along which measurements of any lateral movement of the tracks could be made. Measurements taken at all five stations on December 29, 1933, and on February 28 and June 11, 1934, show that the transverse movement of both tracks has been of no consequence, amounting to only a few sixteenths of an inch one way or the other, with a wide variation in temperature. By far the worst lateral movement was at the end of one of the curves, where, with a change in rail temperature of 107 deg., the track movement was from ¼ in. east of the original alinement to ⅝ in. west of the original alinement, a total change of ⅞ in. The second largest recorded movement, also far above the average, was ½ in., which occurred near the center of another curve, with a change of temperature of 102 deg.



One of the Welded Rail Joints—Note Spring Clip Rail Fastening Used in D. & H. Track Construction

By prick-punching the rails directly beneath the wire base lines when initially set up, the lines also made possible measurement of any longitudinal movement of the rails at the different stations, checking the recorded movement at the joints at the ends. The largest longitudinal rail movement recorded at any of the stations has been 27/32 in., which is far in excess of the average movement at the other stations.

In neither of the two welded track installations has there been any tendency for the track to buckle, even in the hottest weather. At Albany, the track was actually raised and surfaced in hot weather without difficulty. This lack of difficulty with buckling is attributed to the fact that the Albany installation was made in hot weather when the rails were in practically their most extended position. Drops in temperature, it is recognized, cause internal tensile stress in the rails in this installation, which is a maximum in the winter, but a minimum during the spring,

RECORD OF JOINT OPENINGS AT ENDS OF WELDED TRACK
NORTHBOUND MAIN—ALBANY, N.Y.*

Date	NORTH END OF WELDED TRACK				SOUTH END OF WELDED TRACK			
	East Rail		West Rail		East Rail		West Rail	
	Joint Opening Inches	Rail Temp. Deg. F.	Joint Opening Inches	Rail Temp. Deg. F.	Joint Opening Inches	Rail Temp. Deg. F.	Joint Opening Inches	Rail Temp. Deg. F.
Sept. 23, 1933	3/16	NR	1/16	NR†	5/16	NR	3/16	NR
Oct. 13, 1933	1/4	62	7/32	62	5/16	65	3/16	65
Nov. 14, 1933	7/32	37	1/16	37	1/4	48	1/2	48
Nov. 16, 1933	1/4	26	1/4	26	5/16	26	1/2	26
Dec. 15, 1933	3/16	7½	3/16	7½	3/16	7½	7/16	7¼
Dec. 29, 1933	5/16	5	5/16	5	3/8	5	1/2	5
Feb. 15, 1934	1/8	47	1/16	47	3/8	47	9/16	47
June 11, 1934	0	95	0	95	3/16	95	1/4	95

*Insulation thickness deducted where it occurred.
†NR—No record.

Looking North Over the Long Continuous Rails in the Two Tracks at Albany, N. Y.—D. & H. General Office on the Left

summer and fall when most of the track work is carried out. Only when the rail temperature exceeds that at which it was welded and locked in place, will there be any compression in the rail, and, therefore, any tendency for the track to buckle.

On the basis of well-established formulae, the internal tensile stress in the longest rails at Albany, practically fixed as they are against normal expansion and contraction, will reach approximately 19,000 lb. per sq. in. with a drop of 100 deg. below the temperature at which the rails were locked in the track. This extreme in tensile stress will not be reached in the rail in the Mechanicville installation since it was welded and locked in place during cooler weather. On the other hand, with the high temperatures of summer, it is recognized that there will be some compressive stress in this rail.

Only Five Failures

On the whole, the joint welds in both installations have proved satisfactory, there having been no failures to date in the 254 welds at Mechanicville, and only 5 in the 311 welds made at Albany. Of the five failures, two were due to obviously defective welds, while the other three occurred during extremely cold weather in the shorter of the long rails and were identified as closure welds, made under unfavorable conditions. In other words, these three welds were at joints left for expansion during the progress of the work. It is thought that at these joints, the inability of the clamps to pull the long rail sections together with sufficient pressure resulted in poor pressure welding of the rail heads. At all of the joints welded consecutively, as in the case of the northbound track at Albany, with its 2700-ft. rails, and as at Mechanicville, no failures have occurred.

The Delaware & Hudson is not particularly concerned for the safety of its welded track in the event of a fractured joint weld, feeling secure in its double-shoulder tie plate and spring rail clip construction which will prevent the rail from getting out of alinement. If breaks occur at joints or elsewhere throughout the rails because of defects, it is expected that joint bars will have to be applied temporarily, and the breaks welded up later, adding a short section of rail in some cases to insure a sound rail structure.

In the case of each of the joint failures which have occurred, a section of rail was cut out about the break, approximately 20 ft. long, and a new section of rail was Thermit-welded into place to fill the gap. Of the two welds required, one was made without regard to the temperature of the rail, but the second weld, effecting the closure of the track, had to be made when there was a pressure fit between the abutting ends when in final alinement.

To secure the pressure fit necessary to the pressure weld of the head, the insert length of rail was cut slightly longer than the gap in the track rail, during the heat of the day. This was readily set over into place in the cool of the following morning when the rails, with the spring clips released for about 200 ft. each side of the gap, had contracted. Then, with the rising temperature of the day and the resulting expansion of the rails, they soon became under pressure, affording the pressure contact of the rail ends to be welded. Additional assurance of compressive stress in the rail at the closure joints was secured by placing a metal insert, about ½ in. thick, in the joints. This insert extended only about half way down into the web, holding the bases of the rails apart to permit the weld in this area without the necessity of cutting the rails back.

Through the welded joint construction in the installations described, the D. & H. expects that it will effect the following advantages:

Saving in track maintenance, especially at joints.

Increased life of rails through the elimination of end batter.

Saving in labor required in relaying rail.

Reduced mechanical wear of joint ties, with resultant increased life of the ties.

The substitution of its standard intermediate tie plates for the larger and more expensive joint plates which it now uses.

More efficient track signal circuits through the lower resistance of the welded joints, while, at the same time, eliminating the bonding of joints.

Smoother and quieter riding track.

Reduced maintenance of rolling stock and motive power.

That the D. & H. is impressed with the action thus far of its two welded track installations and is convinced of the possible savings and advantages mentioned above, is evidenced in its intention to continue these installations and to install additional sections of welded track in the future. The investigations and work involved in the installations described were carried out under the direction of H. S. Clarke, engineer maintenance of way, assisted in the field investigations by C. E. R. Haight, draftsman, to whom we are indebted for many of the details included in this article.

These Rules Promote Safety

RULES designed to promote safety and economy in the maintenance of bridges and structures were among the subjects discussed at the recent annual meeting of the Association of Maintenance of Way Foremen of the Cleveland, Cincinnati, Chicago & St. Louis, at Cincinnati, Ohio. A list of such rules to be observed by track, bridge and building, and water service foremen was embodied in a report presented by a committee of which C. R. Taggart was chairman. This report is reproduced below.

Inspect Often

As unsafe conditions in bridges and buildings can be created in a short period of time, regular inspections must be made at frequent intervals. Track foremen and track walkers can be of great assistance in reporting unsafe conditions which may exist on bridges or around buildings on their territories. It is their duty to report work which they feel should be done, as it may be months before a bridge and building gang may get to their territory.

Both bridge and building and track foremen should remember that bridges must be kept in line and surface; bolts and nuts must be kept in proper adjustment; bents must be plumb; stringers must have adequate bearing on the caps; and braces must be fastened securely. Track foremen should see that bridge seats, the tops of piers and other readily accessible portions of bridges and trestles are kept free of cinders, dirt and vegetation. They must keep the space under bridges free of vegetation and prevent the growth of vines and other vegetation on masonry. All brush and rubbish that may tend to increase the fire hazard must be removed from the vicinity of all wooden structures. Facilities for extinguishing fires must be maintained in a serviceable condition and receptacles kept filled.

Small defects in buildings, such as broken glass, locks, woodwork, etc., should receive prompt attention.

Broken window glass must be removed carefully by hand and not knocked out. Toilet facilities and water and sewer leads must be maintained in good order. Oil storage facilities should be inspected regularly and pipes should be so maintained that all connections will remain tight.

Special Structures

Special attention should be given to the maintenance of bins, chutes, cut-offs, etc., of coaling stations, and inspections should be made from time to time and corrective measures taken to keep coal sheds and bins free from dirt, coal dust or screenings. The fire protection apparatus on such structures must be inspected and tested at specified intervals and kept thoroughly tight and in working order. Coal must not be wet down either before or after being placed in a wooden coaling station.

Brick or concrete track supports must be inspected closely and repairs made promptly if defects are found. Steel beams supporting tracks at cinder pits must be inspected to determine whether their strength is being affected by hot cinders, and the rail fastenings must be kept in proper condition. An adequate water supply must be maintained around cinder pits, and cinders dumped from locomotives must be wet down immediately to prevent the side walls and track supports from becoming heated. The drainage at cinder pits should be inspected frequently and catch basins cleaned out to prevent cinders from being washed into the sewer. Racks should be maintained so that clinker hooks and shaker bars can be hung up when not in use.

Turntables

Particular attention should be given turntables. Refuse and dirt must be kept off the decks and out of the pits and the latter must be adequately drained. At least once a year turntables should be jacked up and the center bearings thoroughly inspected, cleaned and oiled. The top flanges and cross bracing of turntables should be kept clean, and when tie renewals are made the top flanges should be given a coat of paint. At proper intervals, the entire table should be cleaned and painted; it is false economy to overlook this rule.

Inspection and maintenance work at turntables must not be undertaken without first notifying the operator or before the proper safety precautions have been observed. In cold weather, when it is difficult to rotate turntables, salt must not be used or fires built in such a manner as to damage the steel structure. Where heat is necessary, steam should be used when available. The distance between the ends of yard rails and the ends of turntable rails must not be greater than ¾ in., in order to avoid pounding during the passage of locomotives. The journal bearings of the end wheels should be kept clean and well packed with waste and lubricating oil.

In order to maintain track scales properly, a few simple rules should be observed. Salt or other corroding compounds should not be used for thawing snow and ice about scales. Track forces should take particular care to maintain the proper clearance (⅜ in.) between the rails on the scale and those in the scale track. The cover plates must be inspected to determine whether they have been bent down accidentally so that they bind on the scale. Employees designated to clean and care for scales should be properly instructed. Repairs to scale levers must be made only in a properly appointed scale shop, and scale parts must be kept clean and free from interference. Iron and steel parts, except knife edges and bearing steels, must be painted when installed and at such other times as directed. Scale pits must be kept clean and properly drained and ventilated.

Motor-Car Rules

A number of serious motor car accidents have occurred in recent years which could have been prevented if the proper safety rules have been observed. If motor car operation is to be made safe it is important:

1. To inspect the car before starting.
2. To keep the brakes in good condition.
3. To obtain a line-up of trains.
4. To see that all material and tools are so placed that they will not fall off.
5. To allow no one to get on the car from the sides or front, move around or get off the car while it is in motion.
6. To see that all persons riding on the car are sitting in the proper position.
7. To maintain a lookout in both directions.
8. To keep a constant lookout for objects on the rails, and dogs, chickens, etc., on the track.
9. To operate at speeds not exceeding those specified in the book of rules.
10. To so regulate the speed when approaching a highway crossing at grade as to be able to stop if necessary.
11. To assign each man to his particular duty in removing the car from the track in an emergency.
12. To take no risks and to adopt the safe course.

In conclusion, it is desired to present the following safety pledge. I pledge myself:

To think always of my own safety and the safety of my fellowmen.

To keep my eyes open for unsafe conditions and to take the proper measures for their remedy.

To keep the tools and machinery my men work with in good order.

To wear goggles and have my men wear goggles whenever there is danger of eye injuries.

To attend at once to the most trivial injuries that my men may sustain.

To be helpful to my fellowmen and teach the new man the proper and safe way to do his work.

To be orderly in my habits.

To keep my temper.

To make allowance for the other man's weakness.

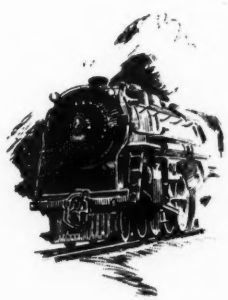
To consider the day lost in which I fail to improve myself, my home or my work.

To be cheerful, hopeful, useful and careful.

Failure to Spike Cause of Derailment

FAILURE to spike ties while making renewals was held to be the cause of the derailment of an engine and a cut of cars on the Chicago River & Indiana near the stock yards in Chicago on May 18, in a report on this accident issued by the Bureau of Safety of the Interstate Commerce Commission. The derailment resulted in the death of the engineman and fireman and the injury of the conductor and a brakeman.

According to this report, the section foreman was engaged in renewing ties under flag protection on the morning of the accident and the derailment occurred during the noon hour, while the section gang was at lunch and the flag protection had been removed. Subsequent inspection of the track showed that of 75 ties in a distance of 120 ft., 36 were not spiked. This condition, plus the high temperature which resulted in tight rail, and the fact that the ballast had been loosened in digging in the ties was believed to have been the cause of the derailment of the locomotive and cars, which were moving at a speed of about 15 miles per hour at the time.



Keeping an Old Viaduct Out of the Scrap Pile

Through the application of electric-arc welding, the Terminal Railroad Association of St. Louis restored to service a severely corroded structure after it had been condemned and closed to traffic

AN expenditure of $600,000 for a new viaduct over the tracks of the Missouri Pacific and the Terminal Railroad Association of St. Louis, at Twenty-First street in St. Louis, Mo., was avoided by restoring the severely corroded members and strengthening other members of the old steel structure at this location. A measure of the physical condition of the old viaduct, which was repaired at a cost of $61,000, is afforded by the fact that it had been closed to all traffic for about two years prior to the restoration. While considerable of the repair work followed usual practice, the project embraced a number of innovations.

This bridge, which was erected and maintained by the city, was built in 1890 and was, therefore, more than 40 years old. During this period there had been a gradual reduction of section in many of its members, particularly in the floor system and lower chords, as a result of corrosion, induced primarily by the action of locomotive gases.

Welding Solves $539,000

When it became necessary to close the bridge, the city prepared plans for replacing it with a concrete viaduct that was estimated to cost more than $600,000, the greater part of which the railways were expected to pay. Obviously they were unwilling to do this, but did make a critical examination to determine the condition of the structure and, as a result, suggested the practicability of repairing and restoring the damaged viaduct to service, largely by electric-arc welding, at a fraction of the cost of the new structure planned by the city. The city finally accepted the suggestion and agreed to the restoration, the work to be done by the railways on terms that were mutually satisfactory. By this method the structure was restored to condition for many more years of service at a cost of only $61,000, or about one-tenth of the cost of the new construction proposed by the city.

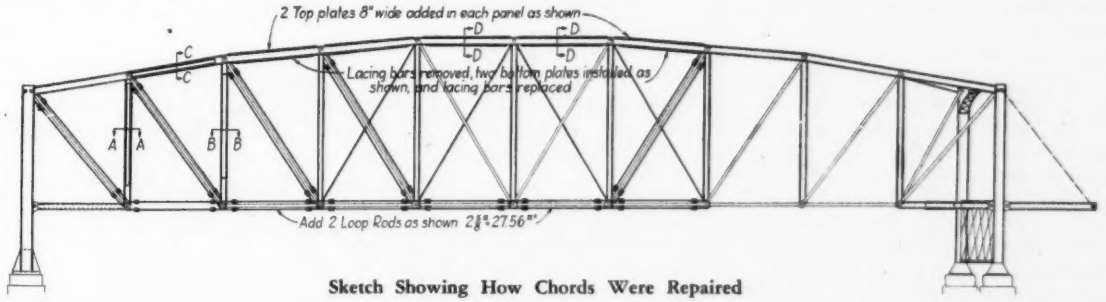
Three Truss Spans

That part of the viaduct which is over the tracks consists of three pin-connected through-truss spans which, beginning on the north, are 150 ft., 204 ft. and 138 ft. long, respectively. The trusses are of the Pratt type with polygonal top chords. They are suspended from heavy two-column bents which rest on stone piers at the track level, by means of pin connections at the ends of the top chords. The members in the end panels of the lower chord, which are also connected to the columns, do not take stress from either dead or live load, but act merely as struts to give longitudinal stability to the supporting bents. The roadway is 31½ ft. wide and two 10-ft. sidewalks are supported on brackets outside of the trusses, which are 34 ft. 6 in. center to center. The spans are on a skew amounting to 8 ft. in the distance between trusses.

Originally, a double-track streetcar line crossed the viaduct, but owing to the gradual reduction in the sections of the members of the floor system, the operation of this line had been abandoned long before the viaduct was closed to other traffic. A subsequent general rearrangement of the routing of street car traffic made this line unnecessary, and in rehabilitating the structure the street car tracks were removed, so that now only vehicles and pedestrians use the bridge.

As a part of the investigation to determine the condition of the structure, careful measurements were made to find out how far corrosion had progressed. These measurements were made at close intervals, but particular attention was given to critical sections as well as to finding the points of greatest damage. In comparing the amount of metal remaining with that in the original sections, it was found that the reduction in area of the floor beams was as high as 14 per cent; in the eye-bars of the lower chord 40 per cent; and reductions as great as 60 per cent were found in the stringers. It was also found that many of the rivets in the built-up members would need to be replaced.

In general, the members above the roadway level were not so severely damaged as those below this level, although even here a few cases of extensive corrosion were found. Most of the reduction in the sections of the lower-chord eye-bars had occurred over the tracks where they had been exposed directly to the blasts from the locomotive stacks. To retard further corrosive attack on the re-



Sketch Showing How Chords Were Repaired

constructed members, it was planned to encase the floor system and lower-chord members in concrete, thus adding appreciably to the dead load. For this reason, the plans for restoring the structure also included the strengthening of these members, as well as the restoration of the original sections. It was also apparent that many of the stringers were too far gone to be repaired, and these were replaced with new material.

Clearance Increased

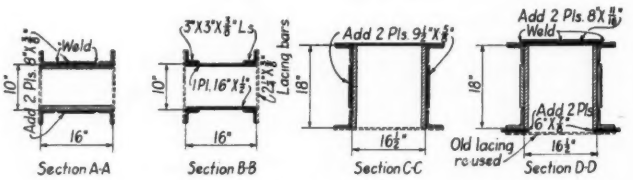
In the original construction, the overhead clearance had been less than that of other bridges in the vicinity, and while it had long been recognized that the clearance should be increased, to do so required either an extension of the approaches or an increase in the approach grades, both of which had been frowned on by the city. The encasement of the floor members made some raise of the bridge necessary, however, and with the consent of the city, advantage was taken of this fact to raise the 204-ft. span about 2 ft.

In making this raise, the granite pedestal blocks which surmounted the stone piers and acted as bearings for the column footings, were cut away sufficiently to make room for the jacks. This left the center portion of each block still supporting the column. The columns were then jacked up and on the remaining part of each granite block a grillage was placed, consisting of three tiers of T-rails. On these grillages, laminated steel-plate bearing blocks were laid, upon which the cast-steel column shoes rest. This entire construction was then encased in reinforced concrete.

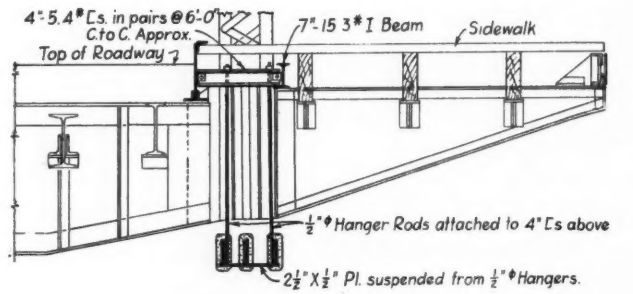
As the old anchor bolts were too short for service after the raise and could not be removed to permit the installation of longer ones without serious damage to the masonry, the difficulty was overcome by extending these anchor bolts by means of sleeves and threaded rods. The raising of this central span cost approximately $8,700, which was in addition to the cost of repairing and strengthening the structure and encasing the floor system.

During the time the viaduct was closed to traffic, a high load, in passing under it, struck and severely damaged the lower chord member L8-L9 and buckled post U8-L8 of the west truss of the center span. Because of this damage, it became necessary to strengthen the lower chord and diagonal members of this truss. As it was impracticable to increase the section of the eye-bar heads, no effort was made to strengthen the eye-bars by welding additional metal to them. Such metal as was applied was intended primarily to restore the section at the point of application, with a reasonable margin to care for future corrosion. This additional metal was applied in the form of plates, the thickness and width of which varied with the amount of section that had been lost, and the depth of the member.

Under the specifications governing the application of these plates, and this applied to built-up members as well, it was required that the member be cleaned thoroughly of rust, dirt, paint, etc., so that only sound metal and clean surfaces would be in contact with the surface of the added metal. The plates were applied symmetrically with respect to the reduced sections of the eye-bars, clamped firmly in position and fillet welded to the member. Fillet welds were required to extend across the ends of the plates and far enough along the edges to develop their full strength. For plates 3/16 in. thick, 3/16-in. fillets were required, while ¼-in. fillets were applied to all plates ¼ in. or more in thickness.



Location of Plates Added to Chords and Posts


4"-5.4# Cs. in pairs @ 6'-0" C. to C. Approx.
Top of Roadway
7"-15.3# I Beam
Sidewalk
½"ϕ Hanger Rods attached to 4" Cs above
2½"X½" Pl. suspended from ½"ϕ Hangers.

Suspension Rods for Eye Bars

Loop Rods Added

To obtain the added section in the eye-bars comprising the lower chord and diagonals of the west truss of the center span, made necessary by the damage which has been mentioned, loop-rods were passed around the heads of the eye-bars and joined with those at the next panel point by means of turnbuckles and threaded rods. All of the loop-rods added to the lower chord were made of Mayari steel, while the connecting rods were of structural grade steel. In this manner, from 4 to 27.56 sq. in. of section were added to the various lower-chord and diagonal members.

Likewise, because of the accident, it became necessary to strengthen some of the upper-chord members by welding additional plates to them, in order to insure that they would function properly. None of the remaining trusses was strengthened, although some reinforcement was necessary because some of the members had been reduced by corrosion.

Since, in general, the treatment of the individual members varied in some particulars from the others, all of them cannot be described in detail, but only typical cases will be given. As already stated, post L8-U8 had been buckled when the high load passed under the span. To repair this damage, a section 21 ft. 9 in. long was cut out and replaced with new material, the ends of the inserted piece being welded to the parts that remained. The make-up of this post is shown in section B-B. Post L9-U9 had been only slightly affected, so that the addition of two side plates, each 8 in. by ⅜ in. by 21 ft. 5 in., totaling 6 sq. in of section, was sufficient to give it the necessary strength. This is shown in section A-A.

The top chord members are of the usual box section, laced on the under side. In panel U8-U9, two side plates, 9½ in. by ⅝ in. by 18 ft. 1 in., were applied in the same manner as those to post L9-U9, to give 11.87

sq. in. of additional area, as shown in section C-C. In panels U7-U8, U6-U7 and U5-U6, which were provided with side plates originally, new plates were added to the cover plates and to the outstanding legs of the bottom angles, as shown in section D-D.

By reference to the drawing it will be noted that owing to the width of the cover plate, 16½ in., the new plates were applied in two 8-in. widths, each of which was welded along both edges and across the ends. To permit the application of the new plates to be made on the lower side of these members it was necessary to remove the lacing bars. The plates were clamped in position and tack welded through the rivet holes in the legs of the angles, and then welded along the edges. The lacing bars were then replaced and secured in the same manner by welding through the old rivet holes and along the edges.

Struts Replaced

The struts in the end panels of the lower chords, which have already been mentioned, also had certain sections badly corroded, which were cut out and replaced in the same manner as post L8-U8. No unusual methods were employed in repairing floor beams and stringers. Stringers that were badly corroded were replaced; others were repaired by the addition of plates as required. In some cases, both the top and bottom flange angles of the floor beams were replaced with heavier sections; in others top and bottom cover plates were added as seemed best suited to correct the conditions.

In working out the plans for the encasement of the floor system and lower chord members, gunite was chosen, since it was believed that it would give the desired protection with the minimum addition to the dead load on the structure. Another consideration that influenced the decision was that forms would not be necessary in applying the encasement. No special problems were involved in coating the surfaces in the floor system, other than those that were created by the large number of train movements under the structure. On the other hand, the weight of the gunite encasement was sufficient to introduce appreciable bending stresses in the eye-bars and loop rods, unless they were given some form of intermediate support. To provide this support, a line of 7-in., 15-lb. I-beams was placed on the top flanges of the sidewalk brackets just outside of the trusses and a line of built-up beams 17 in. deep was placed on the top flanges of the floor beams just inside of the trusses. At about 6-ft. intervals, two 4-in., 5.4-lb. channels, placed back to back, but about ½ in. apart, were framed between the I-beam and the built-up beam, from which ½-in. round hanger rods, threaded at both ends, were suspended by means of plates lying on top of the channels. These rods also pass through similar plates under the eye-bars. The weight of the eye-bars was transferred to the hanger rods by tightening nuts under the plates.

Encased in Gunite

An independent set of hangers from similar channels were provided to support the loop rods. In this case, however, the hanger rods were bent to hook around the loop rods, there being a separate hanger rod at each point of suspension for each loop rod. In both sets of supports, the hanger rods, plates, channels and beams were encased in gunite.

The built-up beam for supporting the hanger rods was designed to serve two purposes, the first of which has been mentioned. The second was to simplify the details of construction by using the web plate and a single top flange angle as the curb for the roadway. It was for this reason that the web plate was made so deep.

As the clearance above the rail still is less than is generally considered desirable, it was thought that measures should be taken to protect, so far as practicable, the gunite encasement from the direct action of the locomotive blasts. As a means to this end, which would add only a negligible amount to the dead load, the entire surface of the encasing concrete was given a coating of emulsified asphalt, which was applied by means of a spray gun. This was done immediately after the application of the gunite to hold its moisture during the period of curing. One of the advantages of this form of protection, which was given weight in deciding to adopt it, is that the coating can be easily and cheaply renewed at any time this may become necessary.

The entire project was planned under the general direction of the late E. A. Hadley, chief engineer, Missouri Pacific, and H. J. Pfeifer, chief engineer, Terminal Railroad Association of St. Louis.

The Problem of Lining Track

EVERY foreman has his own method of lining track. As with practically every other phase of maintenance work, however, certain fundamental and well-defined principles underlie the operation, and the variations in practice have been built upon these, so that the differences are superficial rather than basic. This report deals with the more important considerations in lining track, such as the period of the day most suitable for this work, whether the foreman should face toward the sun or away from it, the influence of variations in the gage, and the distance that the foreman should stand from the lining gang.

The question as to what part of the day is most suitable for lining track is one concerning which there has been considerable difference of opinion. Where the lining is done in conjunction with other work, it should be carried on in the late afternoon, as at this time the sunlight is not so dazzling, the rails have usually cooled somewhat from their maximum temperature and there is less danger of the track buckling.

Where the track is being given a general lining and is not open, the best time to line it is early in the morning or following a rain. If the work is done after a rain, the track is easier to shift and there is also less danger of humping the track if the work is done with track liners. Also, at this time the ballast is less inclined to run under the ties, the rails have probably been somewhat cooled so that the danger of buckling has been reduced, and the light is generally more favorable for the work.

Position Is Important

When lining track the foreman should not face the sun as the reflection makes it difficult to see distinctly and tires the eyes quickly, so that he is unable to distinguish slight or short variations in the line. It is also difficult to see distinctly for any great distance, thus imposing an obstacle to the successful lining of long swings. Many foremen are unable to qualify in their later years because of defective vision. In this way many of them are paying the

*Abstract of a report presented before the annual convention of the Association of Maintenance of Way Foremen of the Cleveland, Cincinnati, Chicago & St. Louis, at Cincinnati, Ohio, by a committee of which J. E. Weber was chairman.

penalty of failure to take ordinary precautions to protect their eyes, but have persisted in the harmful practice of lining track toward the sun.

While variations in the gage affects both line and surface in high-speed track, wide gage that is uniform is not quite so serious as a gage that is irregular. Both, however, have a decidedly adverse effect on the riding qualities of the track. Irregular gage in particular causes cars to lurch from side to side with the result that the track is thrown out of line. Before lining track it should be brought to gage.

Poor Spiking

Poor spiking and the use of worn spikes result in track that is difficult to maintain to good line and gage. If present in sufficient numbers, worn spikes permit tight rail to kink, giving a distorted line. Furthermore, where such spikes are used, the rail shows a greater tendency to creep. Rail that is kinked often requires a permanent set so that it is impossible to line or gage it satisfactorily. When driving spikes, they should always be started vertically and driven straight, since both their holding power and their resistance to lateral

A Section Gang Lining Track

pressure are greater when driven in this manner. Under no circumstances should spikes be set on a slant and then bent toward or over the base of the rail to bring it to gage.

In lining track there are so many varied conditions that must be considered and such a wide diversity of practices in current use that it is impracticable to apply a fixed rule as to the position the foreman should take when lining either tangents or curves. When preparing to straighten a long swing on a tangent the foreman should first make a careful study of the track to be lined. He should view it from both directions, carefully estimating the maximum throw as well as locating the point at which it will occur. With these data well fixed in mind, he may commence work at either end of the swing, increasing the throw to the maximum, then decreasing it until the extreme end of the swing is reached.

The lining of such a section of track may be carried out in two steps, the first roughly by measurements, the second by eye. In the second step, if the shifts that are to be made are less than a rail length long, the foreman should stand from six to ten rail lengths away from the lining gang. If the kinks exceed a rail length, however, he should stand a minimum of ten rails lengths away, to avoid the possibility of putting short reverse swings into the line. Where only short kinks remain to be taken out in the finished lining, the foreman can work to advantage by taking up a position two to five rail length away from the lining gang. Where track is being lined through vertical curves, it is good practice to estimate the location and amount of the maximum throw, and line from that point in both directions to the end of the swing.

More Grade Separation Urged

EMPLOYMENT for nearly three-quarters of a million men, now on relief rolls, can be provided within 90 days on projects for which plans are already drawn, according to a comprehensive survey made public by the Security Owners Association. More than 66 per cent of Class I mileage is covered by the report. The 12,951 projects included in this survey would involve an expenditure of approximately $865,000,000 and

How the States Would Share in the Program

	Number of Projects	Estimated Cost	Estimated Man-Hours of Work
EASTERN DISTRICT			
Connecticut	6	$ 800,000	930,000
Delaware	16	2,651,000	2,669,499
District of Columbia	7	1,130,000	1,115,500
Illinois	1,405	88,002,344	68,234,562
Indiana	2,240	129,014,000	103,934,562
Maryland	47	6,231,078	6,491,077
*Massachusetts	10	1,290,000	1,485,000
Michigan	2,742	158,567,500	130,216,733
New Jersey	127	27,702,000	29,276,000
New York	414	55,594,974	64,650,992
Ohio	1,480	105,369,700	96,492,759
Pennsylvania	208	24,162,389	22,072,084
*Rhode Island	4	485,000	560,000
*Vermont	6	380,000	442,000
Total	8,712	$601,379,985	528,569,783
SOUTHERN DISTRICT			
Alabama	43	$ 1,610,338	1,810,950
Florida	25	597,500	671,972
Georgia	94	4,996,550	5,585,580
Kentucky	687	38,910,000	32,195,252
Mississippi	3	191,587	156,886
North Carolina	142	11,040,000	12,416,026
South Carolina	19	470,500	529,143
Tennessee	11	725,000	815,364
Virginia	1,129	78,128,000	82,307,495
West Virginia	860	54,214,000	51,914,073
Total	3,013	$190,883,475	188,402,741
WESTERN DISTRICT			
Arizona	17	$ 1,089,000	866,700
Arkansas	22	1,236,832	1,104,034
California	99	10,050,000	8,776,090
Colorado	58	3,343,000	2,178,750
Idaho	6	297,000	332,793
Iowa	51	2,910,000	1,456,500
Kansas	125	7,002,985	7,995,532
Louisiana	20	1,427,775	1,300,294
Minnesota	95	4,190,834	2,814,653
Missouri	65	6,069,381	7,096,022
Montana	20	865,000	916,789
Nebraska	54	2,040,000	1,950,516
Nevada	6	400,000	415,612
North Dakota	40	1,529,800	1,182,856
New Mexico	22	1,006,000	1,065,000
Oklahoma	110	4,098,463	4,678,993
Oregon	20	2,400,000	1,834,000
South Dakota	20	649,000	279,280
Texas	210	9,965,437	11,013,880
Utah	14	965,000	337,750
Washington	32	2,775,000	3,228,548
Wisconsin	111	6,737,100	5,462,090
Wyoming	9	303,000	230,000
Total	1,226	$ 71,350,607	66,517,183
Totals United States	12,951	$863,614,067	783,489,706

*Incomplete.

would provide 783,000,000 man-hours of labor, according to the association.

The accompanying table shows how the various states would share in this program, by giving the number of projects for each state, the estimated cost and the number of man-hours of labor that would be provided.

All States Would Share

That this vast program, aimed at promoting highway safety as well as relieving unemployment, would be more of a stimulant to industry than equivalent disbursements through federal emergency relief have been during the past six months was pointed out by Milton W. Harrison, president of the association. The forces of recovery set in motion by this simultaneous release of purchasing power in nearly 10,000 centers of population would be far reaching in their effect", he said. "Expenditures for the rehabilitation of the transportation system, it should not be forgotten, led the way to recovery from the 1920 depression", he declared. He argued that the construction of grade crossing structures is essentially a public obligation and as such falls logically within the realm of the governments' public works program.

A.A.R. Committee

As a means of expediting the formation of plans for the elimination of railway-highway grade crossings with federal funds, which it is proposed to set aside for this purpose, the Association of American Railroads has appointed a policy and an executive committee to function for the railroads. The policy committee, which is composed largely of officers of the A.A.R., will deal with the various government departments and agencies interested in providing appropriations for grade elimination work. The executive committee, which is comprised for the most part of the chief engineers of railroads throughout the country, will serve as a means of contact between the railroads and the policy committee. In addition, to provide a more effective contact with the highway departments of the various states as well as with the district engineers of the United States Bureau of Public Roads, chief engineers or other railway engineering officers have been selected to serve as "state chairmen" and will act as the executive committee's representatives in the various states.

Erie and N. & W. Track Awards

ONLY five or six roads of the many which, in more prosperous times, used to make annual track inspections, continued the practice during 1934, and only a few of these continued to make cash prize awards in connection with their inspections. Two of the roads which have made reports of their 1934 inspections are the Erie and the Norfolk and Western.

Inspection on the Erie

As for a number of years, the Erie continued in 1934 the practice of making an annual inspection of all of its main and branch-line tracks, sending its specially equipped inspection car over the road in a special inspection train. In connection with its inspection, which was made by the system maintenance of way officers, accompanied by the district and division maintenance officers and track supervisors on their respective territories, each section, subdivision, division and district was carefully rated in accordance with the standard of track maintenance obtaining. Certificates were again awarded to the two main-line supervisors on each of the road's two districts whose subdivisions received the highest ratings, and similar awards were made to the two supervisors who maintained the best branch lines on the Eastern district. The names of the supervisors who received the awards in 1934 are as follows:

District	Award
Eastern District—Main Line	
C. J. McNamara, Terminal division, Jersey City, N. J.	First
W. E. Stenson, Buffalo division, Buffalo, N. Y.	Second
Eastern District—Branch Lines	
J. R. MacAsy, Greenwood Lake division, North Newark, N. J.	First
C. L. Connor, Rochester division, Avon, N. Y.	Second
Western District—Main Line	
Ambrose Burgett, Marion division, Huntington, Ind.	First
John Beilby, Mahoning division, Youngstown, Ohio	Second

In addition to the awards made to supervisors, a "Banner" section was selected on each district for a certificate award, and first and second certificate awards were made to the foremen on the different subdivisions whose sections received the highest ratings. The "Banner" award on the Eastern district in 1934 was given to Tony Tufano, foreman, Section 2, Subdivision 1, Bergen County Railroad, while the similar award on the Western district was given to J. C. DeJohn, foreman, Section 41, Subdivision 2 of the Mahoning division.

N. & W. Awarded 81 Prizes

Eighty-one foremen won cash prizes totaling $2,090 on the Norfolk & Western as a result of the annual track inspection held on that road in 1934. Furthermore, according to the ratings established, the tracks of the road as a whole in 1934 reached the highest state of excellence since annual track inspections were inaugurated on the road more than 40 years ago.

As in past years, the inspection was made by separate committees on line and surface, switches and frogs, ditches and roadbed, right-of-way, station grounds, and road crossings, and first, second, third and fourth prizes of $40, $30, $20 and $10, respectively, were awarded generally to foremen on each roadmaster's district.

On the basis of 10 as perfect, the system rating for the year was established at 9.26, two hundredths higher than in 1933, and higher than any previous rating since track inspections were started. On the same basis of 10, the highest division honors went to the Scioto division, with a rating of 9.33, while the second highest division honors were won by the Roanoke terminal, with a rating of 9.32. The highest rating ever given to a roadmaster's district, 9.40, was given to the Tug Fork branch of the Radford division.

Of all the sections on the road, that of Ernal McCann, on the Scioto division at Sardinia, Ohio, (first prize winner in 1933) and that of A. C. Davis, on the Pocahontas division at Tazewell, Va., received the highest rating of 9.49. The section of Brooks Campbell, on the Scioto division at Duvalls, Ohio, which received the second highest rating of 9.47 in 1933, received the second highest section rating of 9.48 in 1934.

Can Track Wrenches Be

This simple tool is characterized by an amazing multiplicity of designs. What can be done about them?

WHY should seven designs of single-end track wrenches, all for one size of bolt, have 30 variations in their principal dimensions? Why should there be 36 variations in these same dimensions in nine designs for another size of bolt? Is there any logical reason why nine designs of double-end track wrenches for three combinations of bolt sizes should have 73 variations in their principal dimensions? This leads to a further query—why are from seven to nine designs of wrenches necessary for a single size of bolt? The force of these questions is emphasized when it is understood that they are based on a study of the designs in use on only 11 roads, which were selected at random for this purpose. They are given further emphasis by the fact that while 48 designs were included in the study, they represent only about two-thirds of the designs in actual use on these 11 roads.

There is no tool used by trackmen in which there is such a multiplicity of designs as the track wrench. In no other tool, except the lining bar, are there so many inconsequential differences. In most cases, except for length, these variations in no way affect the utility of the tool. In fact, many of them are so small that they cannot be detected when two tools of different designs are compared, unless a template or gage is applied. In not a few instances, the differences in identical dimensions between two designs are comparable to the tolerances commonly allowed by the specifications under which the tools are purchased by the railroads.

Many Variations in Dimensions

Among the major variations, designs differ widely as to length and also with respect to the size and shape of the handle. Some handles are flat, others are round, while both shapes may be straight or tapered. Practically all track wrenches have a rounded contour for the external outline of the jaws, but examination of any assortment of wrenches for a single size of bolt will disclose an astonishing variety in the design of the head, brought about by small variations in the radii of the curves which form its outline. In many cases, variations in these radii are also accompanied by variations in the out-to-out width across the jaws, sometimes as little as 1/16 in. As an illustration, reference to the accompanying table will show five different widths across the jaws (dimension B) for nine wrenches designed for use on 1-in. track bolts.

Other variations include radii of such length, either longer or shorter than half the width across the jaws, that the opposite curves are not concentric and the use of two different radii to produce a compound curve for the convex portion of the outline. Similar variations occur in connection with the reverse curves which form the fillet joining the head and handle, while in some instances a short length of straight line is introduced between the curves forming the head and the fillet.

Differences in the width of jaw openings in wrenches designed for use with a given size of bolt are accounted for by variations in the sizes of the nuts used with this bolt by different roads, an example of the manner in which differences in designs for one device affect the designs of others. No relation can be found, however, between the width of the jaws (A) and the depth of this opening (F), these references being to the lettered dimensions on the drawing, since in some designs the depth is greater than the width, in others the two are equal, while in still others the depth is less than the width.

Another dimension which bears the earmarks of personal preference is that of the thickness (C). While the extreme range of this dimension is small, usually from ¾ in. to 1 in., reference to numerous designs discloses that the increase in thickness from the lower limit is made in increments of 1/16 in. Still more impressive is the fact that this same range and the same rate of increase are found in the wrenches designed for use with bolts of every size from ¾ in. to 1-⅛ in., showing somewhat conclusively that, by at least some engineers, this feature of design has not been considered a function of the work required of the tool.

Do Not Affect Utility

Except the width of the jaw opening, not one of the foregoing variations affects the utility of the wrench in any way. In fact, except for the shape of the handle or the length of the tool, only in rare cases would trackmen using these tools be aware of these differences unless their attention was called to them. It matters little to the user whether the curve joining the head and the handle has a radius of 5 in. or 5-⅛ in. Likewise, it is equally immaterial to him whether the curve outlining the head is a simple or a compound curve, or whether these curves are concentric. He is completely indifferent as to whether the depth of the jaw opening is 1-⅜ in. or 1-7/16 in. What he wants particularly is a well-balanced tool that will slip on and off of the nut readily, yet without too much play. In other words, even a casual study of the different designs for track wrenches will disclose that much effort has been wasted on non-essential details.

Length may be considered an essential dimension of a wrench. For this reason, it might be expected that the length of this tool would vary, approximately at least, with the diameter of the bolt on which it is to be used. Yet examination of a large number of designs, in which the lengths range from 18 in. to 54 in., fails to disclose any such relation. While, in general, the shorter tools are used for the smaller bolts, and the longer ones for the larger bolts, wrenches varying from 24 to 48 in. and from 30 to 54 in. are widely used on bolts of the same size. Even the

Be Standardized?

This is the third article of a series dealing with the multiplicity of designs in track materials and tools. In the first article, in the November issue, the general problems of standardization were set forth. Last month, the specific problems connected with rail design and its standardization were discussed. The present article deals with track wrenches and the problems facing railways and manufacturers by reason of the multiplicity of designs of this simple tool. Tie plates will be featured in the February issue.

comparatively small number of designs shown in the table, which lists only nine wrenches for use with 1-in. bolts, illustrates this point, since it will be observed that there are six lengths ranging from 24 to 48 in. while in one case two lengths are shown in the table.

Peculiarities of Design

Another peculiarity of track-wrench design is the treatment given the handle. As mentioned, handles may be either flat or round, with or without taper. It is quite conceivable that one road might prefer a flat handle and another a round one, but why the taper should be only 1/16 in. in one case and ½ or ⅝ in. in another is difficult to understand. It would seem that there will be little difference in service between a straight round handle and one tapered 1/16 in., whatever its length may be. Again, why should one design be tapered so that its smallest diameter is at the outer end and another have the taper reversed to provide the largest diameter at the end of the handle?

The foregoing has reference to single-end track wrenches only, but similar variations are found in double-end designs. In view of the great multiplicity of designs for single-end wrenches, it might reasonably be expected that, as between roads, similar variations will exist in the double-end designs, and this is confirmed by the facts. However, it is amazing that, even on individual roads, there are numerous instances in which identical dimensions in the two types do not correspond. In other words, heads on two types, designed for the same size bolt and the same nut, may differ in one or all dimensions, including the width of the jaw opening. Likewise, some double-end wrenches are straight, while others are S-shaped, the latter also being subject to many variations.

No one, unless he has charted and analyzed these many minute differences in details, can fully appreciate the amazing multiplicity of designs which characterizes this tool, or the inconsequential variations which differentiate many of the designs. The accompanying table illustrates some of the variations that occur between different designs, for a single size of bolt, but it can give only the faintest indication of the total number of designs in current use.

These variations in design have been discussed in some detail to show that, while the tool itself is comparatively simple, the small differences which are introduced by many of the roads, combine to make the total number of designs almost unbelievably large. It has also been shown that many of these differences have no bearing whatever upon the utility of the tool, and that some of them have been introduced without regard to the work expected of it. As an example, if a handle diameter or thickness of ¾ in. is sufficient for a 36-in. wrench that is to be used on a bolt 1-⅛ in. in diameter, why should a thickness of 1 in. be required for the same length of wrench for a ¾-in. bolt?

Another factor bearing on the multiplicity of designs which characterize this simple tool is the frequency with which designs are changed. The most striking fact in this connection is that, in most cases, the changes that are made do not affect the design fundamentally, and many of them are as inconsequential as some of the variations alread pointed out.

Why Limit Designs?

These facts raise other questions. Is there any reason why an engineer should not be free to follow his own ideas in designing wrenches? Is there any disadvantage in the multiplicity of designs that has been pointed out? Is there any advantage in two or more roads using identical designs of wrenches? As with other matters relating to multiplicity of designs, intelligent consideration cannot be given to these queries until all of the facts are known.

In common with other track materials and tools there are two parties at interest in these questions, the railways and the manufacturers. The railway is interested primarily in a tool that will satisfactorily perform the work demanded of it, and that will cost as little as is consistent with this requirement. Tools on one road are used solely on the road that purchases them, practically every road requiring the manufacturer to stamp its initials or monogram on them to identify them as its property. For this reason, so far as its maintenance requirements are concerned, it is of no importance to a road that another road is using the same or some different design of wrench. For the same reason, neither duplication nor diversity of design, as between two or more roads, will affect the size of the stock that must be carried by the stores department on any one of them.

It is evident from the foregoing that, so far as the internal problems of maintenance are concerned, it is of no advantage to a road to adopt a design identical with that used by some other road. Likewise, so far as the same local factors are involved, there is no disadvantage in changing designs as frequently as may be desired. However, there are broader questions of economy to be considered in this connection.

What Is the Effect?

To obtain a clear conception of these broader questions, we must turn to the manufacturer to find how a multiplicity of designs and frequent changes in design affect him, and how they react on the railways. Wrenches are made either on press machines or by the forging process, but in either event they are shaped by dies, a separate die being required for each size and shape of tool. For this reason, when a road changes its design, the

manufacturer must make a new die and, as a rule, the die for the former design becomes obsolete. Yet, the manufacturer can seldom assume that it is obsolete, since it is not uncommon for a road to order tools of a design that has been dormant for as long as 10 to 25 years. Since he must be prepared to make tools of the older design at any time the road may want them, he is compelled to carry the old die in stock indefinitely.

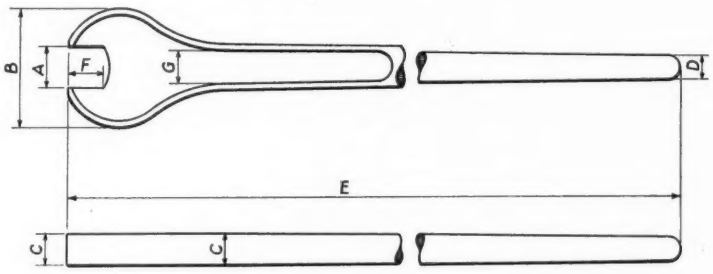
Die Costs Are High

A forging die for a track wrench costs about $250. When an order of one design is completed and before the manufacture of another one can be started, the dies must be changed in the forging machines, at a cost of from $6 to $7.50. Although the cost of press dies is less, averaging about $85, the cost of changing these dies in the machines is about $30. It is obvious that a manufacturer must pass these costs on to the railways.

A study of the cost of producing wrenches discloses an amazing economic waste by reason of the diversity of designs with which the manufacturer must contend. It was stated in the introductory article of this series that in most cases a relatively few designs account for the bulk of the production of an article. This is not true of the track wrench, however. Even the A.R.E.A. designs, which are the most widely used, account for not more than 25 per cent of the total production, the remaining 75 per cent being widely scattered, since most of the roads prefer their individual designs.

Another factor which affects the cost of production is the frequent orders for small lots. While comparatively large orders are not uncommon, many orders call for lots as small as one dozen or even a half dozen. Because of the multiplicity of designs, a manufacturer cannot afford to carry a stock of every design of wrench which he manufactures, since this would not only require much warehouse space but would represent a large investment which would be largely unproductive. Furthermore, because of the ever-present hazard that a road will change its design without notice, he is not warranted in taking the risk of making up a stock from designs which may at any time become obsolete and be left on his hands. For these reasons, with few exceptions, wrenches are made after the receipt of the order, and only in the quantity called for.

Wrenches sell for about $0.50 to $1.60 apiece, the price being based on weight. If an order for only six wrenches is placed, and orders of this size are more common than is generally realized, it costs the manufacturer from $1 to $1.25 a tool to change the forging dies, or $5 a tool in the case of press dies, before he can start making them. Even for a 10-dozen order, these costs are $0.05 to $0.06 and $0.25 respectively, per tool delivered. It will thus be seen that the cost per tool for setting up machines in preparation for actual manufacturer may actually be more than is received for the finished tools.



A	B	C	D	E	F	G
1 1/2	3 7/8	15/16	7/8	42	1 1/4	1 1/2
1 9/16	3 3/4	1	1/2	42	1 3/8	1 1/4
1 11/16	3 7/8	1	3/8	24	1 7/16	1 1/4
1 11/16	4	15/16	1	48	1 3/8	1 1/2
1 11/16	4 1/8	15/16	5/8	40	1 7/16	1 1/2
1 3/4	3 7/8	7/8	3/4	36	1 11/16	1 3/8
1 3/4	4	3/4	3/4	33	1 3/4	1 3/4
1 3/4	4	1	1/2	42	1 1/2	1 1/2
1 3/4	4 1/4	7/8	1/2	36-48	1 7/16	1 1/2

*All dimensions in inches.

Variations in Nine Wrenches for Same Size of Bolt

How Some Orders Are Placed

Illustrating that this is not an imaginary situation, some time ago a manufacturer received an order from a large road for a dozen wrenches of its own design. As this road is a good customer, the manufacturer decided to make up two dozen and hold the extra tools in stock in the expectation that he would shortly get another order, since by doing this he was able to reduce by one-half the cost per tool of changing dies. The expected order did not materialize for almost two years, however, and when it did come in, it called for 14 wrenches. To complete the order, the manufacturer was then compelled to set up a machine and make two wrenches. On the day that this order was shipped, a second order calling for six wrenches came in. This order was scarcely filled when a third order for six wrenches was received, making necessary a third set-up of the machine. The making of these 26 wrenches involved an expense of $21, equivalent to $0.81 per tool, for changing dies alone. To this figure must be added the labor and material of manufacture, accounting and overhead expenses. As the tools were sold for slightly less than $0.70 apiece, it is clear that there was little profit in this transaction.

Can this incident be accepted as typical of the ordering and manufacture of track wrenches? If it is, how can a manufacturer continue to sell his product below cost and remain solvent? The answer is that many orders are substantial and call for enough tools to reduce the unit cost for changing dies to a much lower figure.

There are also other factors which must be considered in this connection. A plant can be operated most efficiently when production approaches a uniform rate. Yet, because of the multiplicity of designs, a manufacturer is unable to take advantage of dull times to build up stocks to meet the demands of other seasons. His operations thus become seasonal, with many roads sending orders during the busy period. As a consequence, there is delay and sometimes confusion in filling orders for tools that are badly needed, while if the manufacturer were able to build up a stock, he could fill orders promtly and with little likelihood of error.

All of these factors react directly on the railways as a whole, increasing the price they must pay for their tools, since the costs of production, whether the manufacturing operation is efficient or wasteful, are, of necessity, passed back to them. As in other instances, however, all of the roads are penalized alike, since for commercial reasons it is impracticable to assess against even those roads that are

the most flagrant offenders in creating waste in production, the added costs which they cause, but the losses must be spread over the entire production of the plant.

Can They Be Standardized?

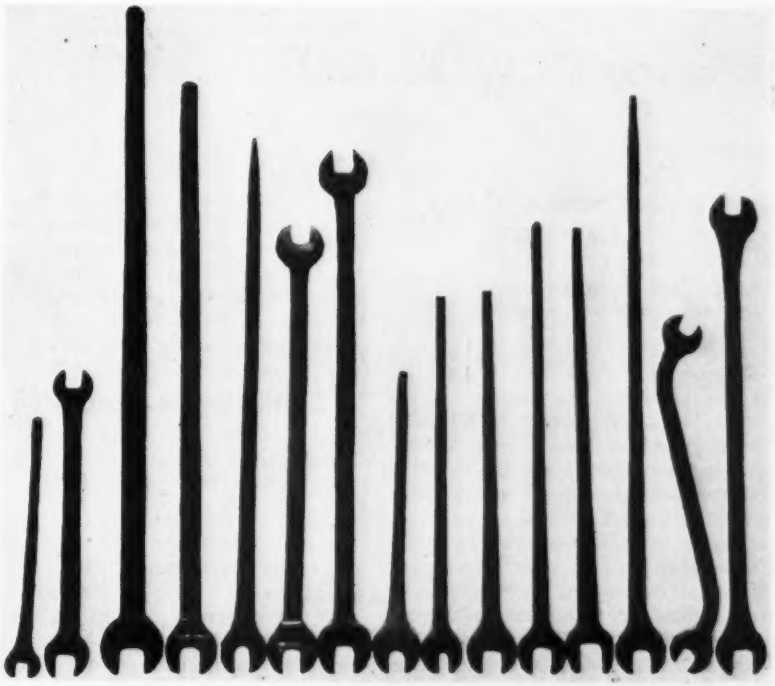
Can wrench designs be standardized? Except the lining bar, the track wrench is probably the simplest tool used in track maintenance; yet it is characterized by a greater multiplicity of designs than any other. As a concrete example of this multiplicity, and of the variations in non-essential details, the accompanying illustration shows 15 different designs of wrenches which were being made in a single plant at the time the photograph was taken. It will be noted that no two of the head designs are alike. It will also be noted that no two of the tools are exactly the same length, although in two cases this difference is within the tolerance limits allowed by most specifications. Particular attention is directed to the handles, which include both straight and tapered designs in both the flat and round shapes. A number of other variations are apparent, while still others are so minute as to escape detection, even when the tools themselves were examined.

A close study of these and other designs shows that there is no fundamental difference in the many designs of the head, and leads to the conclusion that a single design of this feature can be developed which should be satisfactory to all roads. Preference is so strongly intrenched with respect to the shape of the handle, however, that it is reasonable to expect that the basic shapes will persist despite all efforts to reduce this member to a single design. When it comes to length, opinion is as strongly divided, and this becomes another major consideration in the development of a single design for this tool.

Will the roads be willing to accept a single design for track wrenches? In view of the present multiplicity of designs, the fact that there is little indication of a natural trend toward reducing the number of designs, the tenacity with which most engineers maintain their preference for certain major features of their individual designs and the reluctance to accept rigid standards which is so obvious in connection with other materials, it is improbable that any one design of track wrench can be expected to receive wide acceptance.

What is the alternative to rigid standardization? Should the present multiplicity of designs and the economic waste which results therefrom go unchallenged? Or is there some middle ground whereby this waste can be eliminated and yet retain sufficient latitude in design to permit a choice which will meet the needs or desires of individual roads?

Complete standardization of the head design should be possible without affecting the utility of the tool. However, this would only partially solve the problem. Length is of prime importance in the minds of many engineers. Yet the number of different lengths represented in the various designs could be materially reduced without decreasing the ability to obtain tight bolts. In other words, the same results could be obtained on a given size of bolt with two or three properly selected lengths of wrenches as with the 9 or 10 that are now demanded. Likewise, by eliminating the many minute differences in shape of handles and establishing a standard taper for each length of handle, the number of designs for this member would be automatically reduced to perhaps half a dozen.



A Group of 15 Wrenches Illustrating the Wide Range of Designs

Is It Necessary?

Is rigid standardization necessary for economy? In other words, is there a limit in the number of designs beyond which there is little further economy from standardization? It has already been shown that two forms of waste now occur in the production of track wrenches. The first results from the inability of the manufacturer to build up a stock during dull times from which he can draw to fill orders during the busy season. Again, in addition to the necessity for maintaining a large stock of expensive dies, he is compelled to make frequent changes of dies in the forging or press machines as he fills orders for one road after another and when the change must be made for small lots, the cost of doing so may be more than he receives for the tools.

Simplification along the general lines suggested would reduce the number of dies to a few. During dull times the manufacturer could safely make up a stock of each of the limited number of designs in advance of the season of heavy demand.

Rigid standardization is not necessary, therefore, for economy, for if the number of designs can be reduced to a few, the manufacturer will effect the same economy in production that would be possible through concentration on a single design. At the same time, if these designs are so selected as to provide for a suitable number of lengths and of handle patterns, they will retain all of the fundamental features of the individual designs which they replace. Simplification in the design of track wrenches possesses all of the advantages, therefore, of standardization, without its disadvantages.

What's the Answer?

Bracing Shimmed Rails

Where thick shims are used, what methods should be employed in bracing the rail?

Proper Position of Rail Is Important

By J. B. KELLY
General Roadmaster, Minneapolis, St. Paul & Sault Ste. Marie, Minneapolis, Minn.

For shimming up to 2¾ in., the ordinary hardwood shim, at least 6½ in. by 11 in. in plan, bored with four spike holes and varying in thickness by increments of ¼ in., may be used. With these shims, the rail may be braced with hardwood braces 2 in. thick, 6½ in. wide and either 11 or 14½ in. long. They should be chamfered to ¾ in. for 3½ in. on alternate faces at the ends. There should be two spike holes at one end, which are perpendicular to the chamfered surface, so that they will be vertical when the brace is in position against the rail.

The 11-in. brace should be used with shims up to 1½ in. thick and the longer brace for thicker shims. Rail on shims up to 1 in. thick should be braced every fourth tie on tangents and at every second tie on curves. If the shims are thicker than 1 in., the braces should be placed on every third tie on tangents and at every tie on curves. Shim spikes either 7 or 8 in. long should be used with shims 1¼ in. or thicker.

It is important that the rail shall not tip outward when shimmed. Where canted tie plates are in use, the canting can be maintained by placing the plates on top of the shims. Under extreme conditions of high shimming, small ties, preferably hardwood pole ties, with braces may be inserted between the track ties at intervals of about every fourth tie. When shimming in excess of 2¾ in., 3-in. and 4-in. plank should be used, placing the shims on top of them. The plank should be placed with a good bearing on every second tie and secured with six or more 8-in. wire spikes. Holes should be bored in these planks for the shim and brace spikes, to insure against splitting. Ordinarily the plank should extend the full length of the track ties, but where the opposite rails heave unevenly, the planks may be applied in lengths of not less than 3 ft., with the outer ends even with the ends of the ties. This not only supports the shims but provides a good footing for the brace.

Shimming Is Expensive

By R. L. SIMMS
District Engineer Maintenance of Way, Chicago, Burlington & Quincy

Although the shimming of track is not a new development, it still requires the most careful attention at all times. It is only a temporary measure designed to keep the track smooth, but it is an expensive one. For this reason, in a territory where a large number of shims must be used during the winter months, conditions can be improved and the continuing expense reduced by providing adequate drainage, clean ballast and a uniform tie condition. Where winter conditions are severe, it is important that the tie condition be as nearly uniform as practicable, since otherwise shimming may sometimes become necessary, even where the track has not heaved, because after the ballast is frozen, some of the old ties that are weak or soft, located singly or in groups of three or four, do not support the rail as well as the newer and sounder adjacent ties.

On the Burlington, we provide track shims made from hardwood mill waste, designed to fit all weights of rail from 75 lb. to 110 lb., 7 in. by 9 in. in plan and from ⅛ to ¾ in. thick. Shims having a thickness of 1 in. or more are 7 in. by 24 in. In placing shims up to ¾ in. thick, we pull the spikes, plug the holes and place the tie plates on top of the shims. Since the holes in the shim correspond with those in the plate, a 6-in. spike will hold the shim firmly in place and the bored holes avoid trouble from splitting. With these shims we use an oak brace 6 in. by 12 in. by 2 in. thick, chamfered to fit under the rail head and on the tie, with two spike holes for spiking it to the tie. On tangents we brace at every fifth tie; on curves of three degrees or less, at every second tie; and on sharper curves, at every tie.

In addition to holes for track

Send your answers to any of the questions to the What's the Answer editor. He will welcome also any questions you wish to have discussed.

To Be Answered In March

1. *What effect do the higher bolt tensions employed today have on the nuts? Is a change desirable? If so, what?*
2. *What are the most important details to be considered in the maintenance and operation of water-softening plants? By whom should each item be handled? Why?*
3. *On double track, which rail should be selected as the line rail? Why? Should this be continuous or should the line be shifted to the low or the high rail around curves? Why?*
4. *To what extent can rivets be replaced by welding? What are the advantages and disadvantages?*
5. *What is the best method of providing drainage at a highway crossing?*
6. *What difficulties arise in connection with skylights and ventilators early in the spring? How can these troubles be overcome?*
7. *What details of track work should be given preferred attention after the frost leaves the ground but before the roadbed has settled sufficiently to permit surfacing to be done?*
8. *What causes foundation piles to heave as additional piles are driven? What can be done to prevent it? Is this trouble more pronounced with wood or with concrete piles? Why?*

spikes, thicker shims are provided with six holes for boat spikes so they can be fastened securely to the tie independently of the rail fastening. Braces are not used with these shims but are used at the runoff where the thinner shims are employed.

Finds Tie Plates Useful for Bracing Rail

By G. M. O'Rourke
District Engineer, Illinois Central, Chicago

Shimming is not only expensive, but it introduces hazards that should be avoided, for which reasons every practical means should be employed to reduce the number and thickness of the shims where heaving occurs. In almost every instance adequate subsoil drainage will eliminate heaving, even where the heaving has been excessive.

Where heaving does occur, the track should be smoothed by placing shims on the ties; the adzing of ties that have heaved should never be permitted.

Where shims thicker than ¾ in. are used, they should be bored for the spikes, which should be of extra length. When the shims are removed, these spikes should be preserved for use during the next winter. Shims should be of uniform thickness, not wedge-shaped, and, if ½ in. or more in thickness, they should have a minimum length of 8 in. All shims on curves should be accompanied by rail braces, fully spiked, to prevent the rail from tipping out. On tangent, braces are not required except with shims ½ in. or more in thickness. We use tie plates for temporary rail braces with shims, the shims being of sufficient length to allow for boring holes for spiking the braces through the shims. Shims should never be placed on top of the tie plates. Where the plates are used as braces, they should be restored to their places under the rail place when the shims are removed.

Cross-Ribbed Tie Plates

When gaging track where cross-ribbed tie plates are installed, what measures are necessary to prevent the ribs from slipping back into the old grooves?

Should Remove Old Grooves

By C. S. Robinson
Engineer Maintenance of Way, Maine Central, Portland, Me.

It is essential, first, that the old spike holes be plugged thoroughly. Untreated ties should be adzed carefully to remove the old grooves. Treated ties that show considerable cutting from mechanical action should be treated in the same manner and the cut surfaces should be painted with a dependable wood preservative. If the treated ties are in good condition, the plate should be spiked firmly in its new position without adzing. If this is done, the plate will seat itself under traffic without slipping back into the old grooves in the tie.

Widen Grooves by Adzing

By Armstrong Chinn
Chief Engineer, Alton, Chicago

Where the rail is to be moved a distance equal to not more than one-half the width of the ribs, the usual method is to pull all spikes, raise the rail two or three inches, remove the tie plates, plug the spike holes, adze the ties to the depth of the grooves, replace the plates and spike the rail to gage. There are two disadvantages to this method, the first being that a considerable amount of good wood is adzed from each tie, thus reducing the protective outer shell, which not only hastens decay but also weakens the tie through loss of section. Furthermore, the ribs are left standing on a new surface, with the result that the rail is either too high to begin with or settles too low, or it swings above the plate as traffic presses the ribs into the new grooves which are formed as the plate seats itself.

A better way, when it can be done, is to uncouple the rail, throw it in the clear and then, after the plates are removed, plug the spike holes and adze across the ties in the old grooves, widening them in the proper direction by the amount the rail is to be moved. In this way, the minimum amount of wood is cut away and the old bed of the plate is not destroyed, thus leaving the rail on a firm bearing at its original elevation.

Occasionally, track is gaged a distance equal to or greater than the width of the ribs, which places the ribs clear of the old grooves and does away with the danger of the ribs slipping back into these grooves. In this case it is better to adze new grooves for the ribs so that the plates will set firmly on the old bearing at once. Otherwise, traffic must press the ribs into the wood, which, so far as the rail is concerned, brings about the same unfavorable conditions as when the ties are adzed to the depth of the old grooves.

Where cross-ribbed tie plates are used, regardless of the manner in which the track is gaged, some adzing must be done if best results are to be obtained. One precaution to be observed is to see that the adzing is carried completely across the tops of the ties, to prevent the formation of pockets which will hold water and hasten decay. Another precaution, where treated ties are used, is to brush hot cresote on all adzed surfaces before the tie plates are again applied to the ties.

Proper Seating Necessary

By E. L. Banion
Roadmaster, Atchison, Topeka & Santa Fe, Independence, Kan.

This has been a subject of special interest to trackmen ever since cross-ribbed plates came into use. It is not debatable that plates with cross ribs have more lateral stability than flat-bottom plates. Because of complaint that the ribs damage new ties by cutting or crushing the wood fibres, which is true to a limited extent, some roads have adopted the practice of grooving the ties to accommodate the ribs at the time they are pre-adzed and prebored for treatment. This results in immediate seating of the plate and more uniform gage.

It has been noticed many times that, when laying rail, track which has been gaged correctly becomes badly out of gage after a few trains have passed over it. The reason for this is adzing insufficiently to obliterate the old grooves, which allows the ribs to slip back into the old grooves as the plates are seating themselves. Obviously, this cannot happen if the spread of the ribs on the new plates is not the same as on the old ones. Hand adzing seldom gives the desired uniform bearing for the plate, but power adzes correct this trouble and greatly reduce the amount of spot gaging necessary after the laying of the rail is completed.

After new rail is laid, spot gaging or gaging necessary for widening on curves, at turnouts, etc., is at best a slow and unsatisfactory job. However, much work of this nature is constantly necessary and since it is impracticable to remove the rail in short stretches to prepare the tie-plate seat before gaging, it becomes necessary to do by hand such adzing as is required. Furthermore, the old spike holes must be plugged, and to

do this the plates must be removed. As the ribs are usually only about 3/16 to 1/4 in. deep, very little adzing will smooth out the old rib marks, after which the tie plate may be replaced and spiked to gage.

We cannot expect to place the track to such perfect gage, or to hold it, as to eliminate the necessity for gaging as some points which are subjected to horizontal thrusts or pressures. But the point of this discussion is that if the tie plate is seated properly in the beginning, the amount of gaging that will become necessary later will be greatly reduced.

Size and Number Control

By Thomas Walker

Roadmaster, Louisville & Nashville, Evansville, Ind.

Much depends on the size and the number of the cross ribs. Ordinarily, if the gage is sufficiently wide, it is not difficult to shift the plates the amount necessary to correct the gage. But, in general, there is a decided tendency for the plates to slip back into the old grooves, even where the spike holes have been carefully plugged. In such cases it becomes necessary to adze the ties deeply enough to allow the cross ribs to form a new seat. Obviously, this is objectionable, particularly where the ties are treated, as any adzing is injurious since it is done at the most vital point in the tie. An alternative is to plug the old spike holes carefully and pull the tie through the track an inch or so, in order to provide a new seat for the cross ribs. While this entails considerable labor and may disturb the old bed under the tie to some extent, I believe that it affords better protection to the tie than adzing.

It is poor practice to adze treated ties, but in many cases is unavoidable, and may become necessary, even where a tie is pulled slightly across the track. In some instances, particularly when track is being surfaced, the life of the tie can be increased by turning it over to secure a new bearing for the tie plate and thus avoid the damage which ordinarily results from adzing the ties.

What About Driver-Burned Rails?

Should rail that has been burned by slipping drivers be removed from the track? Why? If not, can the surface be restored by welding?

Recommends Taking Them Out of Main Tracks

By W. H. Sparks

General Inspector of Track, Chesapeake & Ohio, Russell, Ky.

I do not care to assume the responsibility for leaving driver-burned rails in the track if the burns are deep or extensive. It has been my observation that while one rail may last indefinitely, another which has apparently received no greater damage will break in a very short time under the same conditions of traffic. Again, many rails break for no reason that we can discover. We are, therefore, taking a long chance when we leave in heavy-traffic or high-speed main tracks a rail which is known to be damaged. There are always places in yards and low-speed tracks where full-section rails can be used to advantage, and the demand for such rails is usually greater than the available supply. It is good practice to use damaged rails in low-speed tracks where there is little likelihood of serious damage if they fail.

As to welding—even with the great advance in this art, and despite trained workmen, I do not believe that it should be resorted to for the purpose of retaining the rail in the main track. Most snow burns occur outside of the joint bars, so that they cannot afford any protection in case a rail breaks through a weld.

Welding May Be Dangerous

By District Engineer

It should not be necessary to remove rails because of light driver burns. Heavy, deep burns are objectionable under high-class passenger traffic because of the noise they create, and they should be removed for this reason. Theoretically, deep burns should weaken the rail, both because of the loss of cross-sectional area and by reason of the structural changes which may take place in the metal, particularly if the burns are sustained in cold weather, and more particularly if the rail is surrounded by snow. Whether burns do materially weaken the rail is a moot question, but it is a fact that failures of driver-burned rails are remarkably rare. It is also a fact, confirmed by experience, that rails removed from first-class main tracks because of deep burns, will carry the heaviest traffic at high speed on freight or secondary lines for years, or until worn out. Despite this, however, rails having burns ¼ in. or more in depth should be taken out of high-speed tracks to be on the safe side.

Welding is definitely known to cause certain structural changes in the metal, and failures have occurred where welds have been made across either the head or the base of rails. On some roads it is permissible to weld burns within the limits of the angle bars, and the results appear to be satisfactory, but under no circumstances should burns outside of the protection of the joints be welded.

Take Them Out of High Speed Tracks

By William Elmer

Assistant Engineer, Pennsylvania, Philadelphia, Pa.

Rail that has a sufficient number of spots burned by slipping drivers, especially if any of the spots are deep, should be taken out of high-speed tracks, if for no other reason than that the cost of the repeated tamping which becomes necessary at short intervals is wasted money. We have seen heavy rail with as many as 25 to 30 burned spots varying from 0.05 in. to 0.1 in. in depth. Such a rail is not even a candidate for welding. Furthermore, I am sure that no experienced maintenance officer would be willing to assume the responsibility of authorizing the building up of one or more burned spots in the middle of a rail that is carrying heavy or high-speed traffic.

Local application of the oxy-acetylene flame or of the electric arc to the surface of the rail head to bring the metal up to a welding temperature is all right within the limits of the joint bars, because a break through the rail within these limits is seldom serious, since the detached parts are held in position by the splices. The art of welding has not yet reached the stage, however, where we are justified in welding outside of these limits. My suggestion is that the burned spots be ground out if they are not too deep or there are not too many of them. This is a matter of comparative costs; if it is less expensive to grind the burns out than to change the rail, all items considered, the grinder should be employed.

Satisfactory results may be obtained with flexible-shaft wheelbarrow-type outfits, several of which are on the market, using an 8-in. cup wheel. They do not occupy the track, which results in a larger proportion of grinding hours. If the trouble is extensive, two, four or six machines

can be worked in a battery, under the direction of one foreman, which will reduce the cost. The runoff on each side of the low spot should be about 0.005 in. per in.

Depends on Depth and Extent of Burn

By C. W. Baldridge
Assistant Engineer, Atchison, Topeka & Santa Fe, Chicago

The decision as to whether driver-burned rail should be removed from the track will depend on the depth and extent of the burns, and on the conditions under which the damage was done. If the driver burns were made by a locomotive while stalled in snow, the rails should be removed if the burns are at all deep, because when engine drivers are spinning in the snow, a red-hot spot developed on the rail is sure to be quenched almost instantly by the snow, causing a layer of very hard metal in and around the burn. Such spots are likely to cause the rail to break if it is left in service. These rails can be used in sidings where movements are slow, but should never be left in main tracks. When driver burns are made under moderate temperature conditions, it is seldom that sufficient hardening of the metal occurs to cause the rail to break, but they do cause track that is somewhat rough-riding and noisy.

Tests have shown that it is not good practice to restore the surface of the rail by welding. In a test made several years ago, 47 spots which had been welded in 13 driver-burned rails were broken under a drop-test hammer. At the same time, 40 pieces of the same rails in which no burns occurred, were given the same test, the maximum drop required to break the undamaged pieces being 17 ft., using a 2,000-lb. tup, while the average was 7.5 ft. Of the 47 welded specimens, 16 broke under a drop of 1 ft.; a drop of only 2 ft. broke 22; 6 broke at 3 ft.; 1 lasted to 4 ft.; and a drop of 6 ft. was required to break the remaining two.

A calculation based on the total foot pounds of energy required to produce fracture of the undamaged and of the welded pieces of these rails, shows that the strength of the burned rails after welding averaged only 17.8 per cent of that of undamaged pieces cut from the same rails. Comparison of this test with another made on driver-burned rails which had not been welded, showed that the welding of the burned rails reduced their strength to less than that of the burned but unwelded rails. The conclusion is, therefore, that the resurfacing of driver-burned rails by welding cannot be justified as a desirable practice to follow.

Laying Prepared Roofing

Is it practicable to lay prepared roofing in cold weather? If so, how should this be done?

Lay Only in Emergency

By J. P. Wood
Supervisor Bridges and Buildings, Pere Marquette, Grand Ledge, Mich.

I am unalterably opposed to the laying of prepared roofing in cold weather, except as demanded by emergencies created by wind, fire, etc. Where it becomes necessary to do so, the best grade of material should be used, since the better the material the better the results. Some of the poorer grades contain foreign substances and some of them are impregnated with coal tar instead of asphalt. Roofing of this grade will split and break in cold weather, and it is quite difficult to get it to lie flat, regardless of how long it may have been warmed. As soon as it is exposed to cold air, it hardens so rapidly that it cannot be laid satisfactorily. Only to a less extent is this also true of the best grades of roofing.

Experience shows that more or less expansion and contraction occur in prepared roofing under temperature changes. If laid in cold weather, it is laid when most contracted, even though warmed prior to application, and as it expands during warm weather it bulges and forms water pockets. When this occurs, and the water remains for a considerable time, the roofing deteriorates and its life is shortened. Roofing has been known to expand enough to pull the nails at the laps and if not repaired at once, it may be further damaged by high winds.

Another objection to cold weather application is that in any event, through continued bulging and contraction, the roofing cracks and causes leaks. This may occur to the extent that the roofing may later be torn by the wind.

In our section we have occasional hail storms during the summer, and even a light hail may seriously damage roofing that is bulged. These objections are so serious that prepared roofing should never be laid in cold weather, if it is in any way possible to avoid doing so.

May Be Practicable But Is Not Desirable

By E. R. Tattershall
Supervisor of Structures, New York Central, New York

While it is practicable, it is not good practice to lay prepared roofing in cold weather if this can be avoided, both because of the nature of the material and the increased cost of application. Prepared roofing is composed of either asbestos-fibre or rag felt, which, in practically all cases, is impregnated with asphalt. The quality and characteristics of asphalts vary considerably, but all have the common characteristic of becoming less plastic as the temperature decreases, thus making the saturated felt less pliable. In fact, it may become quite brittle and tend to crack when unrolled in cold weather or when it is bent to fit the roof surface. The heavier grades of roofing, having a higher impregnation, are more likely to crack open when bent or unrolled.

For these reasons, applications during cold weather require more care and increase the cost proportionately. Among the items of increased cost are some loss of felt as a result of cracking; the increased amount of lap cement required because of decreased fluidity, which reduces the covering capacity; and loss through more of the lap cement adhering to the can as it is poured out. Another item is the decreased efficiency of the workman and probable loss of time to get warm, while more supervision is necessary on a cold-weather job than would be required on the same job done in warm weather.

It is suggested that the roofing and lap cement be stored as close to the work as practicable and at a temperature of 70 deg. or more, if possible. If the job is a large one, it will pay to erect a shanty and install a stove for this purpose, to insure thorough warming. The cement cans should be well protected by wrapping them with an old coat or sack while being taken to the roof. Great care should be exercised to take only well-warmed sheets from near the stove and to get them nailed in place and the lap cement applied before they have time to cool and become brittle or the cement congeals. Only such roofing should be taken to the work at one time as can be applied before it becomes chilled. If it is necessary to bend the felt over the edge of the roof, these sheets should be warmed

carefully and a sufficient number of men employed to do the bending and nailing while the felt remains in a pliable condition.

Supervision must, of necessity, be more rigid to co-ordinate the actual laying, cementing, bending and nailing, so that there may be no delay, and to see that the lap cement is kept sufficiently fluid to insure a dependable job of sealing the felts and of coating the nails and filling the depressions in the felt as the nails are driven home. From the foregoing it is evident that it is practicable to lay prepared roofing in cold weather. It is equally apparent, however, that the costs will be higher than in moderate temperatures, for which reason it is not desirable. Because of this added cost, as well as the possibility of imperfect work, it seems advisable not to apply roofing felts when the temperature is 20 deg. or lower.

The Purpose of Flangers

What is the purpose of a flanger? When should it be operated? What are its limitations?

Flanged Rails Give Better Traction

By H. L. Stein

Roadmaster, Chicago, Burlington & Quincy, Edgar, Neb.

The purpose of a flanger is to remove snow and ice, more generally packed snow, from between the rails so that car and locomotive wheels will have a clear flangeway and the tread a solid bearing on the rail. The ordinary action of the wheels, or the operation of the snow plow, does not remove snow from between the rails, and the continued packing of the snow by the wheel flanges produces so compact a mass that at times the wheels may not even be in contact with the running surface of the rail, and in extreme cases may be derailed. Even where such extreme conditions do not prevail, the lateral pressure exerted against the rail by the packed snow puts a severe strain on the spikes and tends to cause wide gage.

Whenever sufficient snow has fallen to warrant the running of a snow plow, the flanger should follow immediately behind the plow. When snow falls to a depth of six inches or less without drifting, ordinarily one is not warranted in running a snow plow, but the flanger should be put into service to clean the flangeways and clear the area between the rails. Sometimes a storm is so local in character that only a short section of the line, say 40 or 50 miles, is affected, in which case some question may arise as to whether the expense of running the flanger is justified. On the other hand, manual flanging is both slow and expensive and may not be completed before another snow arrives to make a bad condition worse.

It is generally believed that flangers are of little use after snow has accumulated to such an extent that the snow thrown out by the flanger will lay against the drift walls and soon be returned to the track. Obviously, a drift in this condition should be widened as soon as possible with a rotary plow or a spreader, or by terracing. In the meantime, however, it will be a distinct advantage if the flanger is run to afford temporary relief and then again after the snow drift has been widened.

Is Important to Keep Flangeways Clean

By J. J. Davis

Supervisor of Track, Elgin, Joliet & Eastern, Joliet, Ill.

As its name indicates, the purpose of a flanger is to remove snow that lies between the rails to a point below the reach of wheel flanges to prevent the snow from being compacted along the gage side of the rails and in the center of the track. Failure to remove this snow will not only decrease traction and increase the resistance of trains, but it will result in a dangerous condition with alternate freezing and thawing and the fall of additional snow. When additional snow falls on snow in the track that has been allowed to compact thoroughly, and which thaws slightly during the day and freezes again at night, an unusually bad condition is created which may cause derailments.

A flanger should be operated either as a part of a snow plow or as an independent unit, wherever snow conditions demand plowing. Obviously, it should be placed in service as soon as snow conditions require, and its operation should be continued until such time as snow ceases to fall and room has been provided for caring temporarily for the next snowfall. In many cases, drifting will require the operation of both snow plow and flanger two or three days after the storm is over, although no additional snow has fallen in the meantime. Sometimes the flanger alone is all that is needed to accomplish the desired result.

To a large extent, the type of flanger will determine its limitations. Roads using Jordan spreaders find it possible to flange considerably deeper and are able to remove ice and more thoroughly compacted snow than is practicable with independent flangers of the lighter types. Ordinarily, the limit for successful operation of a flanger is a depth of five or six inches of snow above the rails, except when used as a part of a snow plow or spreader. Unless specially equipped for this purpose, flangers are unable to remove ice.

Effect of Anchor Ice at Intakes

What means can be employed to eliminate or minimize the effect of anchor ice at intakes during extremely cold weather?

Still Water Affords Best Protection

By E. M. Grime

Engineer of Water Service, Northern Pacific, St. Paul, Minn.

Anchor ice is formed by the agitation of super-cooled water. If the water remains reasonably quiet, sheet ice will be formed under normal conditions, but when water moves too rapidly for this to occur, the ice forms either as floating feathery particles, resembling snow and called frazil ice, or as fine needles which may become anchored to the bed of the stream or other fixed objects.

It has been noticed that anchor ice usually forms after sunset, before sunrise or on cloudy days. When the sun is up, it apparently warms the bed of the stream sufficiently either to prevent the ice from adhering to the bottom or to loosen and cause to rise to the surface what has already formed on the stream bed. In some swift-flowing shallow streams, such as the Yellowstone river in Montana, the bed will sometimes become so filled with this ice as to form a jam which may hold back practically the entire flow for several days.

This trouble is particularly serious at the intakes of hydro-electric plants in northern latitudes, but is rather unusual at railway water supply in-

takes, because they generally draw water at a comparatively slow rate from a deep pool. One case of a shallow intake in a swiftly flowing cold stream has been corrected by blasting a trench in the rock bottom of the river and extending the pump intake line across the bottom of this trench by means of a long perforated box. This permits the inflow per unit of water-surface area to be slow as compared with that at the end of an ordinary suction pipe where an eddy may form and provide the ideal condition for the accumulation of needle ice during extremely cold weather. The trench is backfilled with broken rock and forms a small reservoir where the water is warmed to a certain extent by ground radiation, and floating ice, of either the anchor or frazil type, passes on to places more favorable for lodgment.

Knowledge of Cause Leads to Remedy

By Inspector of Water Service

Absolutely still water can be cooled to a temperature far below freezing without the formation of ice, but at this temperature the least agitation will result in almost instantaneous solidification of the entire mass. Almost every one in northern latitudes whose winter-time washroom facilities have at times been in the woodshed, has observed this phenomonon. Anchor ice in streams and reservoirs is formed in the same way but, of course, in different surroundings.

Anchor ice may be in either of two forms. One has an appearance similar to snow and is sometimes called frazil ice; it can often be seen forming a collar around rocks that protrude above the surface of the water and as a fringe clinging to vegetation along the shore. The other is needle shaped. In flowing streams, anchor ice may accumulate in masses of varying magnitude which cling to the bed and along the bank. In reservoirs considerable masses may be found floating on the surface. At times these masses may form slowly, at others very rapidly, and may reach an astonishing size, in some cases sufficient to change the course of the stream.

These facts give a clue to the remedy. If water is drawn toward, or flows over, the intake at considerable velocity, anchor ice may be formed in the current or be carried to the suction opening. In either event, there is danger that it will choke the opening and stop the flow. When this occurs, it is extremely difficult to overcome. One instance comes to mind where it was necessary to construct a coffer dam to obtain quiet water and then extend the suction line by means of a larger perforated pipe in order to reduce the velocity of flow from the pool inside of the coffer dam. Basically, the remedy is to prevent floating anchor ice from reaching the intake and then by some method reduce the rate of inflow so that the needles or frazil particles will not form.

Cold Weather and Paint Films

What effect does extreme cold weather have on the paint film on steel surfaces? On wood surfaces? What can be done to overcome the trouble?

Cold Weather Never Causes Elastic Paint to Fail

By E. C. Neville
Bridge and Building Master, Canadian National, Toronto, Ont.

Paint films, whether on wood or steel surfaces, are affected by the expansion or contraction of the underlying material. For this reason, if a paint film has lost its elasticity and has become hard and brittle, there is certain to be checking or cracking as temperature or moisture changes occur, especially if these changes are large. This allows moisture to find its way to the surface of the steel or wood and on metal surfaces starts corrosion. On wood surfaces the moisture spreads through the fibres and the paint soon starts to blister and shell off. A paint that has retained its elasticity does not check or crack as the surface expands or contracts and is not so likely to be affected by extreme cold weather. It appears, therefore, that the use of a tried paint known to have the required elasticity is the best means of avoiding this trouble.

For wood surfaces, No. 1 white lead, properly mixed with a dependable vehicle makes a weather-resisting paint that will retain its elasticity much longer than can be expected from paints of cheaper grade. It will also be found that the best grade of red lead will afford the best protection for steel surfaces in any kind of weather. It is not only the quality of the paint itself that must be considered, however, but the methods of mixing and application, for good results cannot be expected from even the best paint materials obtainable unless proper attention is given to the mixing of these materials, to the preparation of the surface to be painted and to the application.

It is not good practice to apply paint to either steel or wood surfaces in cold weather, since cold thickens the oil to the point where the paint becomes gummy and will not spread properly, even with continued brushing. The result will be a thicker film than necessary and in drying, it will become rough and crinkly. Cold weather also retards drying so that it may be as much as 10 to 12 days before the next coat can be applied. My experience indicates that 45 deg. is about the lowest limit for paint applications that is permissible.

Does Not Affect Good Paint

By H. Cunniff
General Painter Foreman, Delaware & Hudson, Green Island, N. Y.

I believe that cold weather will not affect good paint that has been properly applied over clean surfaces, unless there are severe external conditions such as we had to contend with in our territory during the winter of 1933-34. At that time we not only had very low temperatures at times, but in not a few instances there was a wide range of temperature within limited periods, that is, a comparatively warm day, followed by a severe drop in temperature for a short period and then a quick return to warm weather. These extremes, aggravated by the sudden changes, caused the old paint film to break away from the surface to which it had adhered, and crack and split. The openings thus created became filled with moisture and caused the paint to scale when it was again subjected to low temperature or the metal expanded under the influence of rising temperature.

This experience convinced us that old, heavy paint films lose their elasticity, and when additional paint is applied over them, the situation is aggravated by the presence of moisture and frost. Slow oxidation of paint makes it more or less brittle and unable to adjust itself to the action of rapidly expanding of contracting metal. Bridges and other structures that had been thoroughly cleaned of old paint and coated with a long-oil flexible paint withstood the weather of last winter very well, indicating that the paint film possessed sufficient flexibility to respond to the rapid volume changes of the metal.

We know that when new, a galvan-

ized coating on sheet metal affects the initial adhesion of the priming coat when such sheets are painted. If left unpainted for a time, the coating becomes "cured" and the paint will adhere. Even at this stage, however, the surface is quite smooth and presents practically no "tooth" for the adhesion of the paint. For this reason, the priming coat on a galvanized sheet should have a long-oil vehicle which possesses the maximum flexibility. I am mentioning this because it can be used to illustrate the effect of the rapid and extreme temperature changes which we experienced. One of our minor stations is covered with corrugated galvanized roofing and siding. The roofing was renewed in 1929, at which time the surfaces were washed, cleaned and given three coats of good-quality long-oil paint. At the same time, the old siding, which had not been disturbed, was repainted with the same paint, but over a heavy accumulation of oil paint which was apparently adhering perfectly to the metal. During the winter in question the thermometer registered below zero on 52 days and the temperature changes were very rapid. A spring inspection disclosed that the paint on the roof was in excellent condition, but that on the siding had checked, cracked, flaked and peeled extensively.

Wood surfaces react in much the same manner and there are times when we are inclined to consider a painted surface to be in good condition for repainting, whereas it would be far better to remove the old paint and do a thorough job of preparing the surface for the new paint. The lesson to be learned from our experience is that after a paint film has served its purpose over a reasonable period of years, it is more economical to remove it and clean the surface.

The Pulling of Drift Bolts

Where drift bolts cannot be pulled from stringers or caps by means of claw bars, what alternate method should be employed? What tools are required?

Old Drift Bolts Present Difficult Problem

By L. G. Byrd

Supervisor of Bridges and Buildings, Missouri Pacific, Poplar Bluff, Mo.

Several factors are involved, including the length of the drift bolt, its condition and how it was applied. After long service, an old drift bolt is likely to be corroded and held tightly in the timber, the head may break off during an attempt to remove it and its strength may be considerably reduced. For these reasons special tools may be necessary to pull it. The problem of removal may also be complicated by the location of the bolt or the way it was applied.

It has been my experience that when a claw bar cannot be used, any one of several expedients may be necessary. While the shackle bar is quite commonly used, I do not approve of it, since there is too much hazard of personal injury if the bolt breaks. Another method is to fasten a chain to the bolt by half hitches, then pass it around a timber set across the heads of two ratchet jacks. This method is entirely safe and will remove any bolt, but to make it practicable the bolt must protrude from the timber enough to permit two half hitches with the chain.

I have developed still another method which I consider to be the safest and most economical of any I have seen employed. In this method, the lifting foot of a 15-ton track jack is made to resemble a socket wrench. By slipping the socket over the bolt and inserting a tapered pin, any drift bolt from ⅜ to 1 in. in diameter can be pulled by one man.

Under no circumstances should a line ever be tied to the end of a claw bar or a jack lever for the purpose of allowing men on the ground to pull down on it. Many cases of preventable injury have occurred through this dangerous practice.

Three Designs Are Used

By F. H. Cramer

Assistant Bridge Engineer, Chicago, Burlington & Quincy, Chicago

Three designs of drift bolts, differing only with respect to the head, are used in timber construction: (1) The countersunk head; (2) the square head, an old design; (3) and bolts without head. All three are usually driven flush with the timber, although sometimes the head is allowed to project above the surface to facilitate the use of a claw bar in pulling the drift bolt. When driven flush, it becomes necessary to cut away the wood from around the head to a depth of 2 to 2½ in. to provide for the entrance of the claw bar. This seriously damages the timber and opens the way for decay, particularly if it has been treated.

When a drift bolt cannot be pulled from a stringer with a claw bar, two good sized timbers can be bolted to the piles and used to jack up the stringer. In most cases the bolt will come up with the stringer and, after a slight raise, one or two blows with a maul on the top of the stringer will be sufficient to raise the bolt above the surface enough to get a claw bar under the head. If, however, the bolt does not come through, the stringer should be raised higher and the bolt should be held by a V-shaped tool or claw bar while the stringer is being forced down. If the bolt still refuses to move, the only other alternative is to cut it off between the stringer and the cap with a hack saw. In extreme cases, the drift bolt will remain fixed in the cap and pull through the stringer as it is raised.

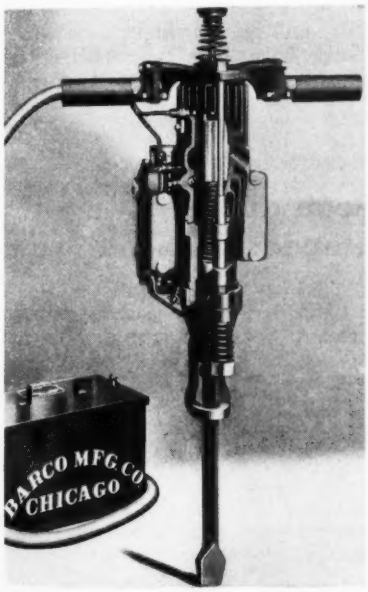
When necessary to pull drift bolts from caps, the two outside bolts can be worked out by the foregoing method. To pull those under the stringers, however, it will be necessary to remove the chord bolts and spread the stringers to get at them, after which they can be pulled in the same manner. Another method is to cut off the piles, remove the caps and pile ends and split the latter, after which the drift bolts can be driven out of the cap. Where it is desired to remove the cap without disturbing the deck, the cut off can be made just sufficient to allow for a double cap. Where this is done, the caps should be fastened together and to the piles by means of splice plates on each side, securely bolted to both caps and to the piles, in addition to the usual drift bolts and dowels.

A Double Header on the Grand Trunk Western

New and Improved Devices

New Portable Gasoline Hammer

THE Barco Manufacturing Company, Chicago, has recently placed on the market a portable gasoline hammer which is applicable to a variety of purposes, such as the breaking of concrete and rock, the tamping of backfill, and the driving of sheeting. This hammer, which is for one-man operation with two hand grips, is of conventional shape. The striking tool is actuated by the free floating steel piston of an air cooled, two-cycle, single-cylinder gasoline engine, which delivers approximately 1,500 blows per minute. The hammer will accommodate any standard 1⅛-in. hexagonal shank tool and weighs 89 lb. in the heaviest size.



The Barco Portable Gasoline Hammer

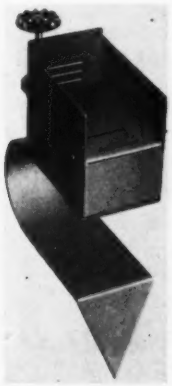
The ignition current is supplied by a nine-volt dry battery and a coil, which are contained in a separate box with the connecting wire to the engine passing through one of the hand grips. The engine uses low-test gasoline, and lubrication is provided by mixing oil with the gasoline, the normal consumption of this mixture being about one quart per operating hour. The fuel tank is fastened directly to the hammer.

The hammer engine is started by turning on the ignition switch and pushing down on the starting plunger provided at the top of the hammer. When the piston travels upward, a vacuum is created which causes a suction in the manifold. This, in turn, causes the lifting of the mixture valve in the body of the carburetor, allowing a charge of gasoline and air to enter the lower compression chamber. During the downward stroke of the piston the gas in the compression chamber is transferred to the combustion chamber through gas passage holes in the piston. Proper timing of the ignition is effected by the action of a piston cam.

New Switch Heater

AFTER service tests last winter, the Howard P. Cook Company, Bridgeport, Conn., is now putting on the market a new switch heater, called the Zaco switch heater. This unit, which is intended to be used in multiple beneath switches, with a central source of fuel supply, is of the box burner type, and is adapted for burning low flash oils, Maloney oil, casinghead gasoline or hydrocarbon.

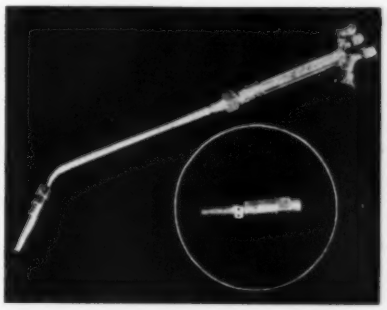
The burner itself is a small ventilated metal box, which is filled with a special asbestos wicking. A small, hand-adjusted needle valve on the rear of the burner regulates the flow of oil to the wicking, and, therefore, to some extent, the size of the flame. Ordinarily, the use of 14 of the burners at a switch has been found sufficient, but as many burners may be used as are found necessary. The units are placed directly beneath the stock rails and switch points, and are held firmly in place by means of sheet metal springs on the bottom. The separate units at a switch are joined in a central gravity supply system by means of pipe and tubing, the same supply being made adaptable, if desired, for serving a number of switch installations in the same vicinity.



A Front View of One of the Zaco Burners

Linde Blowpipe Head Has Three Flames

A NEW welding head designed to facilitate the welding of pipe lines and known as the Multi-Flame Lindewelding head has been developed by the Linde Air Products Company, New York, for use on W-17 and W-22 Oxweld blowpipes. This head consists of a special chromium-plated stem and tip and is available in three sizes, depending on the size of the pipe.



The New Multi-Flame Lindewelding Head. Insert Shows Holes for Auxiliary Flames

The unusual feature is the design of the tip to give three flames, consisting of the welding flame and two smaller auxiliary flames, the latter being so located as to preheat both edges of the vee ahead of the point of welding. With this head it is said to be possible to effect savings of more than 25 per cent in welding rods and gases and of 33 1/3 per cent or more in welding time.

New Books

A.R.E.A. Proceedings

PROCEEDINGS of the American Railway Engineering Association for 1934, 1214 pages, 6 in. by 9 in. Bound in cloth or half Morocco. Published by the Association, 57 East Van Buren street, Chicago. Price, cloth $8, half Morocco, $9.

This volume of the association's proceedings, which is the largest since 1929, contains the reports of the 28 regular and special committees that were presented at the annual convention at Chicago, on March 13 and 14, together with the discussions from the floor. The longest individual report

is that of the Committee on Stresses in Track, covering 240 pages, but while the reports of the other committees occupy far less space, the subject-matter is so diversified as to provide valuable reference material on a wide variety of subjects. Among the many subjects covered are—Protection from Drifting Sand, Scales for Railway Service, Track-Type Tractors in Maintenance Work, Developments in Pipe Joints, Methods of Protecting Treated Wood in the Field, Methods of Inspecting Ties for Renewal, Plans and Specifications for Track Tools, Expansion Joints in Masonry Structures, Hardware for Pie Trestles, and Specifications for Steel Railway Bridges.

A.W.P.A. Proceedings

PROCEEDINGS, American Wood-Preservers' Association for 1934, 523 pages, 6 in. by 9 in. Illustrated. Bound in cloth. Published by the Association, Washington, D.C. Price $6.

Fourteen papers and 13 committee reports, together with the discussions that followed their presentation, are incorporated in the Proceedings of the American Wood-Preservers' Association for 1934. These papers and reports cover all phases of the treatment of wood to resist decay and destruction by insects and marine borers and to reduce its inflammability, as well as the use of treated wood for various purposes. Subject-matter of particular interest to railway men included reports on Tie Service Records, on Bridge and Structural Timber and on Marine Piling Service Records, and a paper on Termites and Methods of Combating Them. However, many of the other papers and reports contain information of definite application to the use of treated wood on the railways. Somewhat out of the ordinary is a paper by Sir. Ralph S. Pearson, that covers the history and present lines of development in wood preservation in Great Britain. Included in the volume, also, are the annual statistics on the Quantity of Wood Treated and Preservatives Used in the United States in the year 1933.

What Our Readers Think

This Tie Plate Refused to Move

To the Editor:

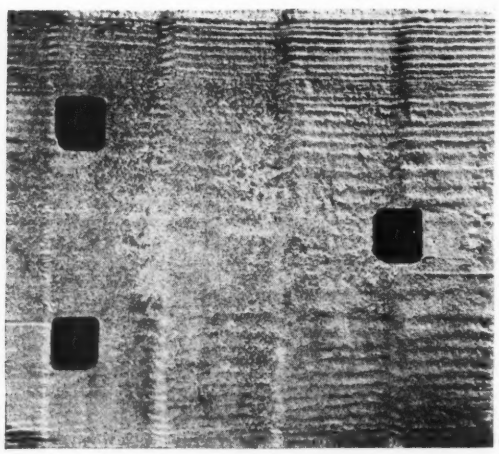
Middletown, N. Y.

I have read with considerable interest the discussions on the fastening of tie plates independently of the rail fastenings, which appeared on page 159 of the March, 1934, issue of *Railway Engineering and Maintenance*. I agree that independent fastenings for tie plates are desirable because they reduce noise and wear, and that with tapered plates they may even be necessary unless there are cross-ribs on the bottom of the plate to help hold it from being crowded out from under the rail, but I contend that there are many miles of properly-laid and well-maintained track where it would not be economical to use independent fastenings, and that it is more important to have the top and bottom of a tie plate parallel than it is to fasten it independently. The desired cant of the rail should be obtained either by stepping the bottom of the plate or by dapping the tie to the desired inclination. In either case, the load on the rail holds the rail and plate in place and before the rail or plate can move out, the lateral thrust must be great enough to raise the loaded plate up the inclined face of the tie.

In support of this contention, my attention was attracted recently to a tie plate which had been removed from the track. This plate was rolled and applied in 1918 and was removed in March, 1934, after 16 years of service, from the low side of a 4 deg. 40 min. curve having 4½ in. superelevation, with 90-lb. RB. section rail canted 1:20 by the tie plate. The maximum axle load is 60,000 lb.

While this type of plate is adapted for use with an independent fastening, the impression made by the wood on the tie plate and the clearness with which the grain stands out, indicate that the plate moved little, if any, during its service life. The tie had not suffered from abrasion under the plate, and an independent fastening would have been a needless expense.

F. J. Meyer,
Assistant Engineer, New York, Ontario & Western.



This Plate Did Not Move in Relation to the Tie During 16 Years of Service

Roofs and Standardization

To the Editor:

I was delighted to learn from your Letter to the Readers in the December issue of *Railway Engineering and Maintenance* that you were going to publish a series of articles on the maintenance of roofs, beginning with the January issue. I have needed information on this subject for a long time, and I am sure that I shall secure much valuable information from these articles.

I am also reading with a great deal of interest your series of articles on standardization. This is as two-sided a subject as one could select and all who read this series will be greatly benefited. The presentation of such sound information on both sides of the subject will prevent any tendency that the reader may have to go to extremes in either direction. As I see it, standardization is excellent within the proper limits, but it certainly must not be allowed to interfere with progress.

Please accept my hearty congratulations upon the excellence of every issue of your magazine.

Chief Engineer Maintenance of Way and Structures.

News of the Month . . .

R.F.C. Loans to Railroads

To November 30 the Reconstruction Finance Corporation had authorized loans to railroads amounting to $446,177,080, of which $432,188,001 had been disbursed and $70,682,258 had been repaid.

Eastman Discusses Control of Water Carriers

The need for federal regulation of all important forms of transportation, including water carriers, was discussed by Joseph B. Eastman, federal co-ordinator of transportation, in an address before the Mississippi Valley Association at St. Louis, Mo. Mr. Eastman said he believed that regulation of the railroads and their rates had much to do with the rebirth and growth of water transportation in the Mississippi valley. Discussing costs, he said that the conclusion is inescapable that expenditures of the government for navigation purposes must be taken into consideration in determining the total cost of transportation on the waterways. Concerning waterways that are already in existence, Mr. Eastman declared that consideration should be given to the question of whether the portion of the cost that is now borne by the public ought to be shifted to the shoulders of those who use and gain direct advantage from the waterways. "So far as new projects are concerned," he said, "the question is whether, considering the total cost involved, the navigation has any important advantages over means of transportation which are already in existence and available . If this question cannot be answered in the affirmative I am unable to see how the project can be justified."

Santa Fe Approves Budget of $21,243,645

The board of directors of the Atchison, Topeka & Santa Fe has approved a budget for capital expenditures for 1935 of $21,243,645. Of this amount $7,030,548 is to be spent on new projects, while the balance of $14,213,097 will be used to complete projects authorized in previous years but now unfinished or not yet undertaken. Approximately $1,600,000 will be spent in 1935 for new rails and fastenings. The road now has on hand 10,743 tons of 112-lb. rails and has already ordered 25,883 tons of rails, both 90-lb. and 112-lb., and 17,700 tons of track accessories. A total of $1,261,000 has been appropriated for track alinement work which will consist largely of the elimination or reduction of sharp curvature in mountain territory to aid in meeting the demands of the public for faster passenger service. A total of $2,250,000 will be spent on the air-conditioning of 280 sleeping, diner, observation, club and chair cars. The principal carry-over items are unexpended appropriations for construction of the Los Angeles Union Passenger Terminal, and the completion of the line from Boise City, Okla., to Las Animas, Colo., and of the line from Farley, N. M., to Colmor, aggregating altogether $9,000,000.

Store-Door Service Proves Success on Pennsy

The growth in popularity of the l.c.l. store-door collection and delivery service inaugurated by the Pennsylvania a year ago is reflected in figures quoted by George D. Ogden, assistant vice-president of the Pennsylvania, in a recent address. "Store-door pick-up and delivery service," he said, "was inaugurated on a system-wide basis by the Pennsylvania in December, 1933, during which month the total number of shipments handled in pick-up and delivery service was 49,000; in February, 1934, it had risen to 148,000; in April to nearly 199,000 and in September to over 268,000 shipments."

"It is the belief of the Pennsylvania management," he continued, "that the logic of events, and the normal and natural progress of railroad transportation, will inevitably make store-door collection and delivery a universal and regular feature of railroad service. One of the interesting and unforeseen results of the store-door service," said Mr. Ogden, "was a gain of 53 per cent in the average load per car of l.c.l. freight, which occurred between December and June, 1933."

Zephyr Creates New Business on Regular Run

The operation of the Zephyr of the Chicago, Burlington & Quincy between Lincoln, Neb., and Kansas City, Mo., during its first 30-day period, resulted in greatly increased passenger business. Between Omaha, Neb., and Lincoln, in both directions, the number of passengers handled increased 111 per cent, as compared with the traffic handled by steam trains during October, 1934. Southbound, passengers leaving Omaha and Council Bluffs for all points, averaged 49 per trip, as compared with 26 on steam trains in October, while the number carried into Kansas City from all points averaged 60 per trip, as compared with 35 during October. Northbound out of Kansas City, passengers for all points averaged 57 per trip, as compared with 31 during October, while the number carried into Council Bluffs and Omaha, from all points, averaged 49 per trip, as compared with 21 during October, an increase of 135 per cent.

The 72 seats on the Zephyr were inadequate on six southbound and four northbound trips. Since December 7, supplementary steam service has been operating daily in both directions, primarily to handle the increased volume of U. S. mail and express. In order to handle the increased business, the road has ordered a fourth car for the Zephyr.

I.C.C. Orders Lower Rates on Grain in West

A general readjustment of rates on grain and grain products within the western district, which, it is estimated, may reduce the revenues of the western railroads by $6,000,000 to $8,000,000 a year, to become effective by April 1, 1935, is prescribed in a report by the Interstate Commerce Commission made public on December 5. The estimated reduction of revenues compare with a reduction of $20,000,000 which the railroads estimated would have resulted from the original order of the commission in this case, which was handed down in 1930. Tariffs filed to comply with that decision became effective on August 1, 1931, but were cancelled February 20, 1932, as a result of a decision of the United States Supreme court, setting aside the order on the ground that general economic conditions had so changed as to make the order incompatible with present conditions.

Rail Earnings for 10 Months and October are Lower

Class I railroads, for the first 10 months of 1934, had a net railway operating income of $391,234,826, which was at the annual rate of return of 1.75 per cent on their property investment, as compared with $398,823,841, or 1.77 per cent, in the corresponding period of 1933, according to figures compiled by the Bureau of Railway Economics. Operating revenues for the 10 months totaled $2,756,973,536, compared with $2,592,587,825 for the same period in 1933, an increase of 6.3 per cent, while operating expenses amounted to $2,048,849,186, compared with $1,870,595,233 for the first 10 months of 1933, an increase of 9.5 per cent.

For October these railroads had a net railway operating income of $48,624,984, or 1.46 per cent, as contrasted with $57,366,045, or 1.71 per cent, in October, 1933. Operating revenues for October amounted to $292,902,774, compared with $294,351,521 in October, 1933, a decrease of 0.5 per cent. Operating expenses in October totaled $212,571,743, compared with $204,713,070 in the same month in 1933, an increase of 3.8 per cent.

Places Steam Train in New High Speed Service

A high-speed steam-driven passenger train, the first to be designed to compete with modern streamlined diesel electric trains, was placed in service on January 2 by the Chicago & North Western between Chicago and the Twin Cities on a schedule of seven hours for the 408½ miles. The decision to inaugurate this train, which is to be known as "The 400," was made following the announce-

ment of the Chicago, Burlington & Quincy that it had ordered two light-weight stream-lined trains which it would place in service between Chicago and the Twin Cities in February. The maximum average speed of "The 400" between stations will be 75 miles per hour. The schedule of 7 hr. is 2 hr. 50 min. less than the present fastest time made by this company's trains between these points. The train will be operated in each direction daily. It will be drawn by a 4-6-2 type locomotive converted to burn oil, on which the diameter of the 75-in. drivers has been increased 4 in. to make possible speeds of 100 m.p.h. or more. In each direction the train will consist of five modernized and air conditioned steel passenger cars.

Administration Plans Transport Legislation

A program of transportation legislation to be actively pushed at the coming session of congress is understood to be under consideration by the administration. Co-ordinator of Transportation Joseph B. Eastman has indicated that, in a series of reports which he is to submit to Congress through the Interstate Commerce Commission, he will reiterate his recommendations of last March for regulation by the Interestate Commerce Commission of truck, bus and waterway transportation, while further reports are forthcoming dealing with the subsidization of water and highway transportation and proposed labor legislation, including a pension plan and one for the payment of a dismissal wage to employees laid off as a result of economy projects. Further recommendations for consolidation legislation and for amending the railroad provisions of the bankruptcy law are expected.

I.C.C. Approves Loan for Wabash

In a decision dated December 15, the Interstate Commerce Commission approved the application of Norman B. Pitcairn and Frank C. Nicodemus, receivers of the Wabash, for a loan of $2,350,000 from the Federal Emergency Administrator of Public Works, to be used in the completion of a new bridge across the Missouri river near St. Charles, Mo., to replace the existing Wabash bridge in the same location. According to the commission's order, the construction of a new bridge, which is required in the interest of public safety, will enable the Wabash to use its heavier power and at the same time remove the speed restrictions which now limit movement to 10 miles an hour over the existing bridge, and, in connection with certain line changes also to be made, will establish a grade of 0.5 per cent instead of an existing grade of 1 per cent in the direction of heavy traffic.

According to the plan proposed by the receivers, the new bridge will be owned by the Wabash-St. Charles Bridge Company, a proposed subsidiary of the Wabash, and the loan from the PWA would be secured by first mortgage bonds of the bridge company.

Association News

Maintenance of Way Club of Chicago

Forty-five members and guests attended the meeting of the club on Wednesday evening, December 19, when G. M. O'Rourke, district engineer Illinois Central, read a paper on Grinders—Their Place in Rail-End Welding. Mr. O'Rourke's paper was supplemented by a moving picture illustrating welding and grinding practice.

Metropolitan Track Supervisors' Club

The December meeting of the Metropolitan Track Supervisors' Club, with approximately fifty in attendance, including a number of higher engineering officers, was held at the Hotel McAlpin, New York, on December 13. The speaker at the meeting was H. S. Clarke, engineer maintenance of way of the Delaware & Hudson, who discussed the practicability of eliminating the present type of rail joints through welding the rails together in track.

The next meeting of the club will be held in the evening of February 19, at the new place of meeting, the McAlpin, Thirty-Fourth street and Broadway.

Wood-Preservers' Association

The thirty-first annual convention will be held at the Hotel Pennsylvania, New York, on January 22-4. Among the features of the Tuesday afternoon program of special interest to railway users of treated timber are the reports of committees on Pressure and on Non-Pressure Treatment of Poles and on Service Records of Ties, of Bridge and Structural Timber and of Poles. Tuesday evening will be devoted to the consideration of treated material for port structures, with papers on The Use of Treated Material in Port Structures in New York Harbor by Francis J. O'Keefe, chief engineer, department of docks, New York City, and on Decay and Marine Borer Resistance of Creosoted Piles and Timbers in Tidewater by Dr. Hermann von Schrenk.

At the Users' Day session on Wednesday forenoon, papers will be presented by George W. Rear, engineer of bridges, Southern Pacific Company, on the Southern Pacific's Experience with Treated Timber in Bridge Construction, and by H. R. Clarke, engineer maintenance of way, C.B. & Q., on the Experience of the Chicago, Burlington & Quincy with the Treatment of Crossties.

Arrangements have been made for western members to leave Chicago on the New York Central at 5:30 Sunday evening, January 20, with connecting cars from St. Louis and possibly also from Cincinnati and to stop at Rome, N.Y., on Monday morning to visit the plant of the American Creosoting Company and arrive in New York that evening.

American Railway Engineering Association

Most of the committees completed their work for the year during November; three, however, found it desirable to hold meetings in December to complete the year's work, these being Economics of Railway Labor at Chicago on December 3; Track at Chicago on December 11; and Rail at New York on December 18.

Only one committee has a meeting scheduled for January, this being Yards and Terminals, which will meet at Buffalo, N.Y., on January 15, to outline its work for the coming year.

Bulletin 371 will be in the mail the first week in January and the remaining bulletins will follow in quick succession.

National Railway Appliances Association

A total of 71 railway supply companies have already agreed to take space in the National Railway Appliances Association exhibit of materials and equipment employed in the construction and maintenance of railway tracks, structures, signals and other fixed properties at the Coliseum, Chicago, on March 11-14, inclusive, concurrent with the annual conventions of the American Railway Engineering Association and the Signal Section, A.A.R. Over 72 per cent of the space available in the main building has been allocated and the directors of the association have arranged to lease the north annex of the Coliseum if additional area is needed.

Exhibiting Members

Adams & Westlake Company
American Steel & Wire Company
American Car & Foundry Company
American Fork & Hoe Company
Armco Culvert Manufacturers' Association
Austin-Western Road Machinery Company
Air Reduction Sales Company
Barco Manufacturing Company
The Barrett Company
Bethlehem Steel Company
Carnegie Steel Company
Caterpillar Tractor Company
Chicago Pneumatic Tool Company
Chipman Chemical Company
Cleveland Frog & Crossing Company
Cleveland Tractor Company
Crerar, Adams & Co.
Cullen-Friestedt Company
Dearborn Chemical Company
DeVilbiss Company
DeSanno & Son, A. P.
Paul Dickinson, Inc.
Eaton Manufacturing Company
Electric Storage Battery Company
Frog Switch & Manufacturing Company
Gardner-Denver Company
Industrial Brownhoist Corporation
Illinois Steel Company
Ingersoll-Rand Company
Inland Steel Company
International Harvester Company
Johns-Manville Sales Corporation
Jones & Laughlin Steel Company
Jordan Company, O. F.
Kerite Insulated Wire & Cable Company
LeCarbone Company
Lehon Company, The
Locomotive Finished Material Company
Lorain Steel Company
Lundie Engineering Corporation
Magnetic Signal Company
Maintenance Equipment Company
Massey Concrete Products Corporation

WOODINGS-VERONA TOOL WORKS

SINCE 1873

We wish to extend to all our patrons and friends, our wish for a really prosperous New Year.

WOODINGS FORGE & TOOL CO.

VERONA, PA.

Mechanical Manufacturing Company
Metal & Thermit Corporation
Morden Frog & Crossing Works
National Carbide Sales Company
National Carbon Company
National Lock Washer Company
Nichols & Brother, George P.
Nordberg Manufacturing Company
Okonite Company
Oxweld Railroad Service Company
Pocket List of Railroad Officials
Pyle-National Company
Racor Pacific Frog & Switch Company
Rail Joint Company
Railway Purchases & Stores
Railway Track-Work Company
Ramapo-Ajax Corporation
Rawls Company, S. E.
Republic Steel Company
Ross & White Company
Simmons-Boardman Publishing Company
Sperry Products, Inc.
Standard Equipment Company
Teleweld, Inc.
U. S. Wind Engine & Pump Company
Western Railroad Supply Company
Wilkening Manufacturing Company
Youngstown Sheet & Tube Company

Associate Members

Celotex Company
Chicago Flag & Decorating Company
Copperweld Steel Company
Corning Glass Works
Electric Tamper & Equipment Company
Fairbanks, Morse & Co.
Fairmont Railway Motors, Inc.
General Railway Signal Company
Kalamazoo Railway Supply Company
National Aluminate Company
National Lead Company
P. & M. Company
Positive Rail Anchor Company
Railway Maintenance Corporation
Warren Tool Corporation
Weir, Kilby Corporation
Worthington Pump & Machinery Company
Pittsburgh Plate Glass Company
Frog & Switch Manufacturing Company

A.A.R. Elects Officers

Progress in building up the organization of the American Association of Railroads, successor to the American Railway Association, has now proceeded to a point where there are very few vacancies in official positions. M. J. Gormley, president of the American Railway Association, has been elected executive assistant to J. J. Pelly, president; Harold J. Forster, secretary and treasurer of the A.R.A., will continue to hold the same position with the A.A.R.; and Stanley J. Strong, secretary and treasurer of the Association of Railway Executives, has been elected assistant secretary and treasurer. All but one of the vice-presidents have been selected. James R. Downs, assistant vice-president of the Pennsylvania, has been elected vice-president in charge of operations and maintenance. R. V. Fletcher, general counsel of the A.R.A., has been elected vice-president and general counsel of the A.A.R. August F. Cleveland, vice-president, rates and divisions, of the Chicago & North Western, has been named vice-president in charge of traffic, while Edward H. Bunnell, chief accounting officer of the St. Louis-San Francisco, has been elected vice-president in charge of the department of Finance, Accounting, Taxation and Valuation.

Personal Mention

General

A. F. Barclay, chief engineer maintenance of way and structures of the New Orleans Public Belt, has been promoted to general manager, with headquarters as before at New Orleans, La.

Norman M. Lawrence, division engineer on the Philadelphia Terminal division of the Pennsylvania, whose promotion to superintendent of the Erie & Ashtabula division at New Castle, Pa., was noted in the December issue, was born in Chambersburg, Pa., on June 7, 1890. He attended public schools and Chambersburg Academy and in July, 1906, entered the service of the Cumberland Valley (now part of the Pennsylvania) as a clerk in the office of the purchasing agent and storekeeper. He attended Pennsylvania State College from 1907 to 1911, and during vacations and until August, 1913, he was employed in the Cumberland Valley engineering corps and as a foreman on construction work. At the end of this period he was transferred to the Pennsylvania as a rodman on the Tyrone division, serving in that capacity until his entrance into military service in August, 1917. In June, 1919, he returned to the Pennsylvania as assistant supervisor on the Cresson division, next serving successively on the Philadelphia and the Maryland divisions in the same capacity and as supervisor of track on the Williamsport and New York divisions. Mr. Lawrence was appointed division engineer on special duty in the office of the general manager, Eastern region, Philadelphia, Pa., in July, 1928, with later service as division engineer on the Elmira, St. Louis and Philadelphia Terminal divisions.

Norman M. Lawrence

J. J. Daley, assistant division superintendent and supervisor of track on the New York Central, with headquarters at Alliance, Ohio, has been promoted to superintendent of the Ohio Central division, with headquarters at Columbus, Ohio. **C. M. McVay,** assistant engineer, with headquarters at Columbus, Ohio, has been promoted to assistant superintendent of the Cleveland division, with headquarters at Alliance, to succeed Mr. Daley.

Mr. McVay was born on April 3, 1886, at Xenia, Ohio, and attended Washington and Jefferson college. He entered railway service in July, 1905, with the Pennsylvania, leaving this company in December, 1907, to become assistant division engineer on the Toledo & Ohio Central (now part of the New York Central). Two years later Mr. McVay was appointed assistant engineer maintenance of way of the Kanawha & Michigan (now also part of the N.Y.C.), being advanced to engineer maintenance of way of this company, with headquarters at Charleston, W. Va., in 1914. On January 1, 1919, Mr. McVay was appointed division engineer on the New York Central, with headquarters at Charleston, holding this position until June, 1927, when he was made engineer of construction of the Nicholas, Fayette & Greenbrier (owned jointly by the N.Y.C. and the Chesapeake & Ohio). On August 1, 1931, Mr. McVay was reappointed division engineer on the New York Central at Charleston, being appointed assistant engineer, with headquarters at Cleveland, Ohio, on November 1, 1931. He was transferred to Columbus, Ohio, on March 1, 1933, where he was located at the time of his recent promotion to assistant superintendent, with headquarters at Alliance, Ohio, effective December 1.

George N. Slade, assistant superintendent of the Lake Superior division of the Northern Pacific, and formerly an assistant roadmaster with this company, has been promoted to superintendent of the Yellowstone division, with headquarters at Glendive, Mont. Mr. Slade was born in July, 1902, at Englewood, N. J., and was educated at the Sheffield Scientific School, Yale University. He entered railway service in February, 1925, in the engineering department of the Northern Pacific, serving as a chainman and a rodman until 1926, when he was advanced to assistant roadmaster at Duluth, Minn. Later in the same year, Mr. Slade was transferred to the operating department as assistant trainmaster at Helena, Mont., being promoted to trainmaster at Jamestown, N. D., in 1927. In 1928, he was transferred to Minneapolis, Minn., and in the following year he was appointed superintendent of ore operations, with headquarters at Superior, Wis. In January, 1933, Mr. Slade was appointed assistant superintendent at Duluth, Minn., the position he was holding at the time of his recent promotion.

Engineering

George C. Wendling, assistant division engineer on the Louisville division of the Louisville & Nashville, has been promoted to division engineer of the Birmingham division, with headquarters at Birmingham, Ala., succeeding **Robert N. Crapster,** whose death is noted elsewhere in these columns. **Robert M. Leeds,** road-

master on the Louisville division, has been appointed assistant division engineer on the same division, to succeed Mr. Wendling.

Mr. Wendling, who is 46 years old, first entered the service of the Louisville & Nashville on May 27, 1914, as a draftsman in the chief engineer's office at Louisville, Ky. He has held the positions of instrumentman, assistant engineer, roadmaster, assistant division engineer and division engineer and has served on the Nashville, Memphis and Louisville divisions. He was appointed assistant division engineer of the Louisville division with headquarters at Paris, Tenn., on January 16, 1934.

Mr. Leeds was born 47 years ago, and entered the service of the L. & N., on October 1, 1910, as an instrumentman in the construction department. During the next three years he served in this position and as a rodman and masonry inspector, and on May 1, 1913, he was appointed assistant engineer on the Evansville division. He was promoted to roadmaster on October 1, 1916, and served continuously in this position at various points until his recent appointment as assistant division engineer.

E. E. Young has been appointed division engineer of the Hannibal division of the Chicago, Burlington & Quincy, with headquarters at Hannibal, Mo., succeeding **F. W. Jansky,** whose death is noted elsewhere in these columns.

F. E. Bates, assistant bridge engineer of the Missouri Pacific, and formerly bridge engineer, has been re-appointed to the latter position and **S. L. Wonson,** assistant chief engineer and bridge engineer, has had his title changed to assistant chief engineer. The headquarters of Mr. Bates and Mr. Wonson are at St. Louis.

L. E. Gingerich, whose promotion to assistant division engineer on the New York division of the Pennsylvania, with headquarters at Jersey City, N. J., was noted in the December issue, was born on December 7, 1889, at York, Pa., and was graduated from Gettysburg college in 1922. He entered railway service as a rodman on the New York division of the Pennsylvania on December 4, 1922. In September, 1926, he was promoted to assistant supervisor on the Baltimore division, and in October of that year he was transferred to the Philadelphia division. In July, 1928, he was promoted to supervisor of track on the Williamsport division and a year later he was transferred to the Philadelphia division. In January, 1931, Mr. Gingerich was transferred to the Baltimore division, and in May, 1934, he was assigned to special duty on the same division, which position he was holding at the time of his recent promotion.

Track

John P. Datesman, assistant roadmaster on the Wisconsin division of the Chicago & North Western, has been appointed roadmaster on Subdivision 5 of the Iowa division, with headquarters at Council Bluffs, Ia., succeeding **L. Dippert,** deceased.

Mr. Datesman was born on November 22, 1897, at Douglas, Wyo., and studied civil engineering at Iowa State college. He entered railway service on December 19, 1919, with the Chicago & North Western, serving as a rodman in the engineering department at various points until June, 1924, when he was appointed a concrete inspector on bridge construction at Casper, Wyo. In December of the same year Mr. Datesman was sent to the chief engineer's office at Chicago as a draftsman, being advanced to assistant engineer in July, 1926, serving in this position at various points until December, 1931, when he was placed on bridge construction work as an inspector. In May, 1933, he was advanced to assistant roadmaster on the Wisconsin division, holding this position until his recent promotion to roadmaster at Council Bluffs, effective November 25.

J. T. Loftus has been appointed acting roadmaster on the Superior division of the Chicago, Milwaukee, St. Paul & Pacific, with headquarters at Channing, Mich., succeeding **H. Lindeman,** who has been granted a leave of absence.

G. J. Nash, who has been connected with the American GEO Company at Chicago, and who was formerly a supervisor of track on the Illinois Central with the same headquarters, has been reappointed supervisor of track with headquarters at Rockford, Ill., succeeding **J. Pierce,** whose death is noted elsewhere in these columns.

Edward T. Barrett, assistant supervisor of bridges and buildings on the Northern Pacific, with headquarters at Glendive, Mont., has been promoted to roadmaster on the Fargo division, with headquarters at Fargo, N. D., succeeding **R. A. Sharood,** who has been transferred to Spokane, Wash., as noted in the December issue. Mr. Barrett was born on April 20, 1905, at Minneapolis, Minn., and was educated in civil engineering at Marquette University. He entered railway service with the Northern Pacific on June 24, 1926, as a draftsman in the general office at Minneapolis, later serving in this position on the location of the Redwater branch in Montana. In July, 1927, Mr. Barrett was appointed a transitman on construction on the same line, holding this position until June, 1928, when he was appointed building inspector. In April, 1929, he was transferred to location work on the Olympic Peninsula in Washington, and in the following year he was made a track apprentice. Mr. Barrett was appointed assistant bridge and building supervisor on the Yellowstone division in May, 1933, which position he was holding at the time of his recent appointment as roadmaster on the Fargo division.

Mark C. Fox, whose promotion to supervisor of track on the Pennsylvania, with headquarters at Kittanning, Pa., was noted in the December issue, was born on September 1, 1907, at Zanesville, Ohio. Mr. Fox received his higher education at Purdue University and entered railway service on June 17, 1929, as assistant on the engineering corps of the Philadelphia division of the Pennsylvania, with headquarters at Middletown, Pa. In September of that year he was promoted to assistant supervisor on the Baltimore division, with headquarters at York, Pa., and a year later was transferred to the Delmarva division, with headquarters at Clayton, Del. In May, 1932, Mr. Fox became assistant foreman on the Eastern Region electric welding train, and in December of that year he was made general foreman of the train. Later in the same month he was appointed assistant supervisor on the Middle division, with headquarters at Newport, Pa., and in February, 1933, he was transferred to the Maryland division, with headquarters at Perryville, Md., where he was located at the time of his recent promotion to supervisor of track.

Bridge and Building

C. J. Voss has been appointed to the newly-created position of superintendent of bridges and buildings of the Green Bay & Western, with headquarters at Green Bay, Wis.

J. P. Mills, assistant supervisor of bridges and buildings on the Scioto division of the Norfolk & Western, has been promoted to supervisor of bridges and buildings of the same division, with headquarters at Portsmouth, Ohio, succeeding **C. P. Tracy,** who has retired. The position of assistant supervisor of bridges and buildings on the Scioto division has been abolished.

Mr. Mills was born at Sciotoville, Ohio, on April 8, 1880, and entered the service of the Norfolk & Western on November 28, 1893, as a carpenter on the Scioto division. In 1910, he was promoted to assistant carpenter foreman and later he was made assistant supervisor of bridges and buildings on the same division. Mr. Mills was transferred to the Radford division on June 14, 1931, returning to the Scioto division later in the same year where he was located at the time of his recent promotion.

Obituary

J. Pierce, supervisor of track on the Illinois Central with headquarters at Rockford, Ill., died on November 23.

Robert N. Crapster, division engineer of the Birmingham division of the Louisville & Nashville, with headquarters at Birmingham, Ala., died on October 1.

C. E. Anderson, roadmaster on the Chicago, Burlington & Quincy, with headquarters at Burlington, Iowa, died suddenly on December 19.

James Bolton, roadmaster on the Chicago, Rock Island & Pacific, with headquarters at Haileyville, Okla., died at McAlester, Okla., on December 12, following a long illness.

J. W. McKinney, who retired in 1931 as supervisor of bridges and buildings of the St. Louis division of the Illinois Central, with headquarters at Carbondale, Ill., died on December 18, at Carbondale following a long illness.

ADDED SAFETY FOR HIGH-SPEED TRAINS

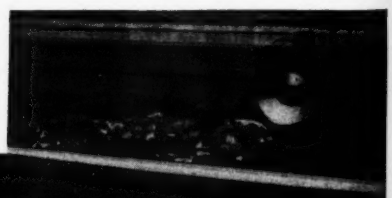
BETHLEHEM PERFECTS FIVE-POINT SAFETY SWITCH CONTROL

New Device Gives Positive Distance Signal Warning of Danger at Switches

Bethlehem Steel Company has introduced a new switch control operating in conjunction with a distance signal bringing an added degree of safety to the operation of high-speed trains. It is known as the Bethlehem Positive Signal Stand—A Five-Point Safety Switch Control.

This Bethlehem Positive Signal Stand combines the functions of a switch stand, the throwing of a derailer in a turnout, a distance signal indication, a facing-point lock and a switch-point detector.

With this device, any switch in track-circuit territory, however remote, can be made as safe as one controlled from an interlocking plant. A complete check is given on faulty conditions at the switch, even in cases where the target indicates clear. If a switch is run through and the points left open without changing the target position, the Bethlehem Positive Signal Stand gives an automatic warning of this condition, at the distance signal. Regardless of the distance to the protective signal location, an unsafe condition at a switch instantaneously shows a danger indication.



Proved in Service

The Bethlehem Positive Signal Stand installation is used in connection with either one of two well-known, thoroughly tried and proved switch stands, made by Bethlehem Steel Company. A latch, lock and electric circuit control complete the assembly. These have been given a thorough service trial and have demonstrated complete reliability.

Complete detailed information on this development will be supplied upon request.

BETHLEHEM *POSITIVE* SIGNAL STAND

FIVE POINTS OF SAFETY

1 Danger is indicated the instant the latch holding the switch-stand lever is lifted.

2 Danger is indicated as soon as the switch points are moved more than ⅛ inch from their main-line position, and danger continues to be indicated until they are restored to the main-line position and locked.

3 Danger is indicated if the switch is run through, leaving the switch points open ⅛ inch or more.

4 Safety is indicated only when switch points are in correct position for safe main-line operation, and the switch-stand lever locked.

5 Switch points protected by a positive safety point-lock automatically operated by the switch stand.

BETHLEHEM STEEL COMPANY

GENERAL OFFICES: BETHLEHEM, PA. *District Offices:* Atlanta, Baltimore, Boston, Bridgeport, Buffalo, Chicago, Cincinnati, Cleveland, Dallas, Detroit, Heuston, Indianapolis, Kansas City, Milwaukee, New York, Philadelphia, Pittsburgh, St. Louis, St. Paul, Washington, Wilkes-Barre, York. *Pacific Coast Distributor:* Pacific Coast Steel Corporation, San Francisco, Seattle, Los Angeles, Portland, Honolulu. *Export Distributor:* Bethlehem Steel Export Corporation, New York.

At the time of his retirement, Mr. McKinney had been connected with the Illinois Central for 41 years. He was born on December 20, 1863, and entered the service of the company in January, 1890, as a bridge and building carpenter. Six years later he was promoted to carpenter foreman and in January, 1906, he was advanced to general foreman in the bridge and building department. Three years later Mr. McKinney was promoted to supervisor of bridges and buildings of the St. Louis division.

Fred J. Nannah, engineer maintenance of way of the Pittsburgh & Lake Erie, with headquarters at Pittsburgh, Pa., died on December 10. Mr. Nannah was born at New Brighton, Pa., and was graduated from Geneva college, Beaver Falls, Pa. Shortly after his graduation he became connected with the Pittsburgh & Lake

Fred J. Nannah

Erie, as a chainman on the engineering corps, and since then has been in the constant employ of this road. Mr. Nannah was promoted successively through the positions of rodman, transitman, assistant engineer and valuation engineer and engineer of construction. He was promoted to engineer maintenance of way, at Pittsburgh, in 1931.

William H. Bremner, receiver of the Minneapolis & St. Louis, and an engineer by training and experience, died on December 12 at his home at Minneapolis, Minn. While studying engineering at the University of Iowa and for several years following his graduation, Mr. Bremner was connected with the engineering department of the Chicago, Burlington & Quincy.

F. W. Jansky, division engineer of the Hannibal division of the Chicago, Burlington & Quincy, with headquarters at Hannibal, Mo., died on November 26 following a heart attack. Mr. Jansky was born on June 4, 1871, at St. Louis, Mo., and prior to entering the service of the Burlington in 1905, he served in the army engineering corps during the Spanish-American war. From 1905 to 1920, he held the positions of instrumentman and assistant engineer on the Burlington at St. Louis, then being appointed division engineer. He was serving in the latter position with headquarters at Hannibal at the time of his death.

Supply Trade News

General

The Republic Steel Corporation is spending $500,000 for a new building and new finishing equipment in its Youngstown, Ohio, electric weld tube mills. The new building will house equipment and provide additional storage space for finished pipe.

The Republic Steel Corporation, Youngstown, Ohio, has appointed the **Buhl Sons Company,** Detroit, Mich.; the **F. W. Heitmann Company,** Houston, Tex., and the **Woodward Company,** Albany, N.Y., warehouse distributors of Enduro stainless steel. **The Steel Products Company,** McKees Rocks, Pa., has been appointed warehouse distributors of Republic's Toncan iron sheets in the Pittsburgh area.

Personal

H. N. Pickett, formerly advertising manager of the Daily Metal Trade, has been appointed advertising manager of the **Toncan Culvert Manufacturers' Association,** Youngstown, Ohio.

Fred W. Venton, assistant manager of the railroad sales department of the **Crane Company,** Chicago, has been promoted to manager of that department, with the same headquarters. Mr. Venton was born in Cleveland, Ohio, on November 14, 1881, and was educated at

Fred W. Venton

Armour Institute of Technology, Chicago. During the early part of his career he was employed in the shops of the L. H. Prentice Company, and the Chicago, Burlington & Quincy, while later he served as chief engineer of several hotels in Chicago and of the McClintock estate. In 1910, he entered the service of the Crane Company as traveling engineer and in 1915 he was promoted to assistant manager of the railroad sales department, which position he held until his recent promotion.

C. Parker Holt has been made executive vice-president of the **Caterpillar Tractor Company,** Peoria, Ill. **Thomas J. Conner** has been appointed vice-president in charge of manufacturing and has been elected a director to fill the vacancy on the board caused by the recent death of **Pliny E. Holt.**

Paul W. Gregory, head of the culvert department of the **Wheeling Corrugating Company,** a division of the **Wheeling Steel Corporation,** with headquarters at Wheeling, W. Va., has been appointed general manager of the **Canton Culvert Company, Canton, Ohio,** a subsidiary of the **Republic Steel Corporation,** to succeed **F. A. Kelly,** who has been appointed president of the Toncan Culvert Manufacturers' Association, Youngstown, Ohio, and head of the culvert division of the Republic Steel Company.

Trade Publications

Republic Steel at A Century of Progress—The Republic Steel Corporation, Massillon, Ohio, has issued a 12-page rotogravure tabloid containing illustrations of exhibits presented at A Century of Progress Exposition for 1934, in which the products of this company were used or displayed.

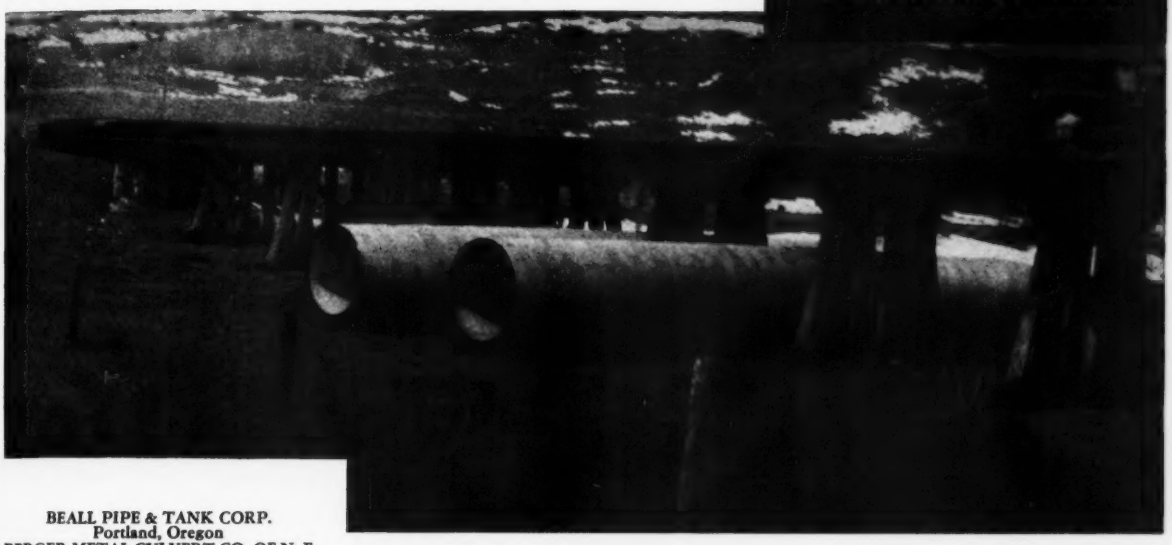
Airco-Wilson Arc Welders.—The Air Reduction Sales Company, New York, has issued an attractive and informative booklet, the first to have been prepared dealing with the Airco-Wilson arc welding machines distributed by this company. The booklet, which contains eight pages, outlines in some detail the features and advantages of the Airco-Wilson machines, and contains a comprehensive group of tables showing the types, capacities and operating characteristics of the different welders available for different classes of welding work.

Precautions and Safe Practices.—The Linde Air Products Company, New York, has issued a completely revised edition of its booklet, Precautions and Safe Practices, having to do with the storage, care and handling of oxy-acetylene welding and cutting equipment. The new edition which is up-to-date with the advances which have been made in the oxy-acetylene process itself, is essentially a brief and practical list of "do's and don't's," so that those concerned may understand the precautions and care necessary to the safe and economical use of the oxy-acetylene process.

Sheet Iron Primer—The Republic Steel Corporation, Massillon, Ohio, has published a revised edition of its Sheet Iron, A Primer. In this 64-page booklet the manufacture of sheet iron is dealt with in 19 chapters which explain in non-technical terms the various steps in the production of sheet iron, from the mining of the ore to the rolling of the finished sheet. The booklet also discusses the importance of iron, explains the annealing, galvanizing, and galvannealing processes, discusses the various impurities of iron, explains the effects of rust and corrosion, and discusses the various alloys of iron.

DENVER & SALT LAKE RAILROAD REPLACES 100 TIMBER STRUCTURES WITH

TONCAN COPPER MOLYBDENUM IRON CORRUGATED PIPE



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BERGER METAL CULVERT CO. OF N. E.
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EASTERN CULVERT CORP.
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A. N. EATON METAL PRODUCTS CO.
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H. V. JOHNSTON CULVERT CO.
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WM. E. NEWMAN & SONS CO.
Ogden, Utah
THOMPSON MFG. CO.
30th & Larimer Sts., Denver Colo.
TRI-STATE CULVERT MFG. CO.
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WESTERN PIPE & STEEL CO.
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TONCAN CULVERT RAILWAY SALES
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In its program of road-bed improvement, the Denver & Salt Lake Railroad found it advisable to replace timber trestles with Toncan Iron Corrugated Pipe. To date, about 100 replacements, representing a total length of three miles, have been accomplished, the corrugated pipe being placed in position and the trestles back-filled without interference with regular train schedules.

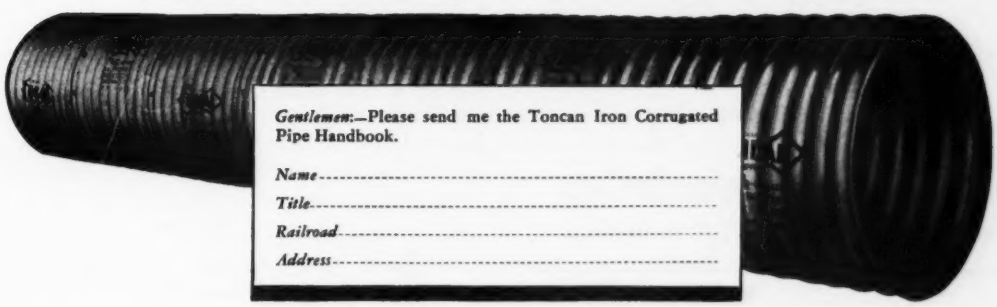
The durability of Toncan Iron was given careful consideration when the selection of materials was under discussion, and Toncan Iron Corrugated Pipe was adopted due to its widespread and well-earned popularity in railroad service.

Toncan Iron is a modern metal—an alloy of refined open hearth iron, copper and molybdenum possessing the highest corrosion-resistance of any ferrous material in its price class. Toncan Iron Corrugated Pipe is economical—easily and quickly installed—immune to the vibration and punishment of heavy traffic—free from maintenance expense—and long lasting.

This modern drainage structure is described in detail in the Toncan Iron Corrugated Pipe Handbook. A copy will be sent upon request.

TONCAN CULVERT MANUFACTURERS' ASSOCIATION

REPUBLIC STEEL CORPORATION BUILDING • YOUNGSTOWN, OHIO



Gentlemen:—Please send me the Toncan Iron Corrugated Pipe Handbook.

Name.....

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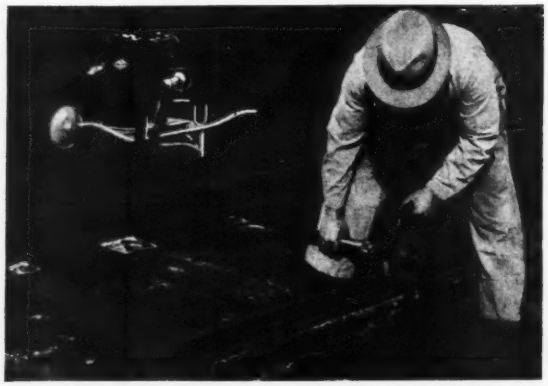
PORTABLE FLEXIBLE SHAFT GRINDER



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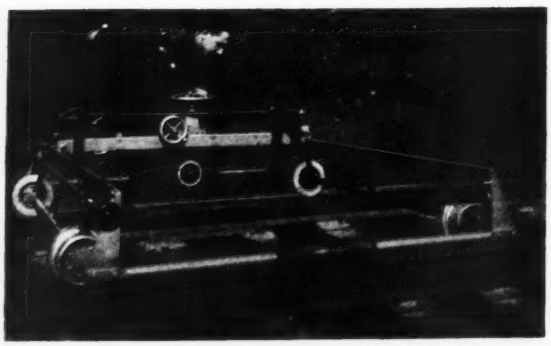
Rail grinding equipment is our entire business. Our machines and abrasives are in service almost everywhere rail has been laid. The line of Railway Trackwork Co. grinders embraces a wide range of models, both gasoline and electric, to meet various conditions. Every model has been fully developed and its effectiveness has been demonstrated. Many roads regularly place repeat orders. Focusing our entire attention on rail grinding frequently enables us to suggest previously unsuspected economies. Consultation will be welcomed at all times.



MODEL P. 21
PORTABLE TRACK GRINDER

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BOOKS THAT HELP MAINTENANCE MEN

Track and Turnout Engineering

By C. M. KURTZ
Engineer, Southern Pacific Company

This new handbook for location, construction and maintenance of way engineers, transitmen and draftsmen, gives practical mathematical treatment of track layout and other problems. These are fully exemplified and worked out in detail, and illustrated with drawings of accepted designs for fixtures and track layouts. It contains original as well as a complete set of standard railway engineering handbook tables. All computing problems which may arise in track engineering are thoroughly treated.

457 pages, 116 illustrations, 33 tables, flexible binding, 5x7, $5.00

Practical Track Work

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Formerly Supervisor, Pennsylvania Railroad

A new book giving expert information on the design, fabrication and installation of standard railroad trackwork. Thoroughly describes switch stands, switches, frogs, crossings and slip switches.

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Packed full of practical information written on a background of 25 years experience. The meat of modern maintenance practice is in this book. It is the most complete work on the subject.

Second Edition, 226 pages, 44 illustrations, cloth, 6x9, $2.00

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This little book has practically revolutionized curve and switch calculation practice since its appearance 12 years ago. The proved accuracy of its methods has caused them to be adopted as standard practice on many roads.

Complex algebraic and geometric calculations are reduced to their simplest form and as nearly as possible to terms of simple arithmetic. Application of these calculations to the actual job is made plain by brief explanations. Drawings further clarify the subject and make the meaning of the text unmistakable. Tables of dimensions are a further help to the track foreman.

Short cut formulae are featured. String lining and tape line layouts are fully explained. While retaining practically all of the rules and principles which have been tested in previous editions, changes have been made in several detailed features to correspond to improved designs. A flexible binding makes the new edition more convenient to slip in the pocket and carry on the job.

Fourth Edition, 212 pages, 24 illustrations, 5x7, cloth, $2.00

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Please send me for 10 days' free examination the books checked below. I will either remit list price or return the books within that time.

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ON THE First Solid Steel-Deck Railroad Bridge*

The new nine-span bridge superstructure, built for the Susquehanna River crossing of the Reading Company, marks the first use of a solid steel deck on a railroad bridge.

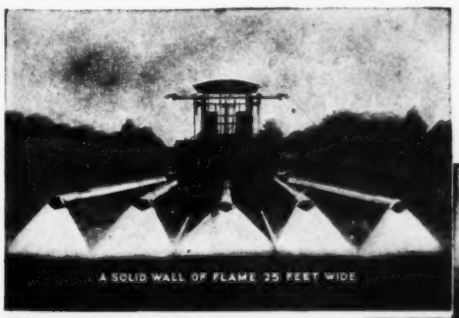
The Phoenix Bridge Co., in erecting this superstructure, used two Industrial Brownhoist cranes; one of 60, the other of 50 tons capacity. Commenting on their cranes, this company says, "We have used Industrial Brownhoists since 1916 and our experience with them has been very satisfactory. The cost of maintenance has been very reasonable, considering the heavy work required of them."

** Described in November 22nd issue of Engineering News Record.*

GENERAL OFFICES: BAY CITY, MICHIGAN

INDUSTRIAL BROWNHOIST

NEW YORK, PHILADELPHIA, CLEVELAND, CHICAGO



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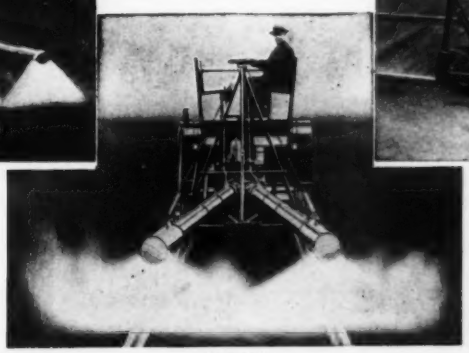
The Giant "Octopus"

Woolery Control-Type Railway Weed Burner built in 3 and 5-burner types. The widest burning and most flexible machines yet produced. Outside burners may be swung in or out, up or down at the will of the operator while the machine is in operation. Each burner under separate and positive control. The long side arms may be swung out to burn to a width of 45 feet to burn out ditches and assure good drainage.

Think of it! A burning speed of from ½ to 15 miles per hour at a cost of from $3.50 to $6.00 per mile—twice over. And we guarantee to prove it at any time—anywhere—by a demonstration on *your* road at a time when vegetation is at its worst.

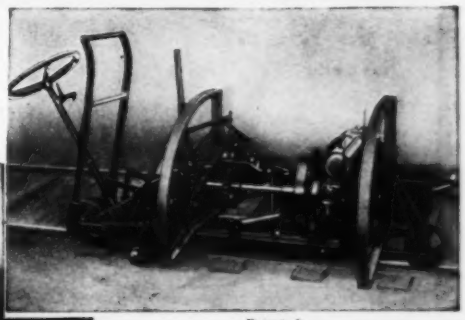


Patented

The Midget "Octopus"

Especially adapted for Short Line Railroads, etc. Presents a solid wall of flame 10 feet wide or its long arms can be set to burn to a width of 18 feet. By a simple change of the burner heads this machine can be transformed from a Weed Burner to a snow melting machine.

Many Roads are using them for snow melting with remarkable results.



Patented

Woolery Power Bolt Tightener

An automatic power machine for tightening bolts on rail joints, or for removing nuts from old bolts. It will tighten bolts on from 200 to 300 joints per day on existing track, and on from 150 to 200 joints when laying new rails. It will keep bolts tight for a longer period and lowers the cost of keeping them tight.

Read This Working Report From One of the Large Northwest Railroads:

Date	Hour Operation	Hours Helper	Number Joints	Gal. Gas Used
Oct. 12-29	8	8	210	5
Oct. 13-29	8	8	210	5
Oct. 14-29	8	8	215	5
Oct. 15-29	8	8	220	5
Oct. 16-29	8	8	220	5
Oct. 17-29	8	8	230	5

Send for Literature Illustrating and Describing These Machines in Detail

WOOLERY MACHINE CO. **Minneapolis, Minn.**

Inventors and Manufacturers of Railway Maintenance Equipment

NO-OX-ID
IRON-OX=RUST
TRADE MARK
The Original Rust Preventive

This bridge structure has had first application of NO-OX-ID "A Special" to kill the corrosion. When inspection shows all rust killed, the surface will receive a coating of NO-OX-ID Gloss Filler Red over which a black coating will be applied.

The Economical Positive Method of Steel Maintenance in Railroad Service

Kill the old rust and pits by an application of NO-OX-ID "A Special." Permit the sun and warm weather to assist it in soaking to the seat of pits. Action of the material will cause the larger accumulations of rust scale to loosen and fall away. These bare patches should be touched up from time to time while this gradual preparation of the steel surface is in progress. When the NO-OX-ID has penetrated thoroughly, simply remove any excess NO-OX-ID, and rust scale that has loosened from the surface, and apply a coating of NO-OX-ID Gloss Filler Red as a prime coat.

The composition of NO-OX-ID is such that it acts both mechanically and chemically. With this proven inhibitor next to the steel surface, use your standard paint for a final coat, if desired, or complete the job with the NO-OX-ID method.

NO-OX-ID stops the corrosion that has started; greatly reduces the cost of cleaning and effects the result of sealing the steel surface with a proven rust inhibitor. It gives long life and eliminates the necessity of recleaning at time of recoating.

Dearborn Chemical Company

310 S. MICHIGAN AVE., CHICAGO 205 EAST 42ND ST., NEW YORK
Canadian Factory and Offices: 2454-2464 Dundas St., W., Toronto

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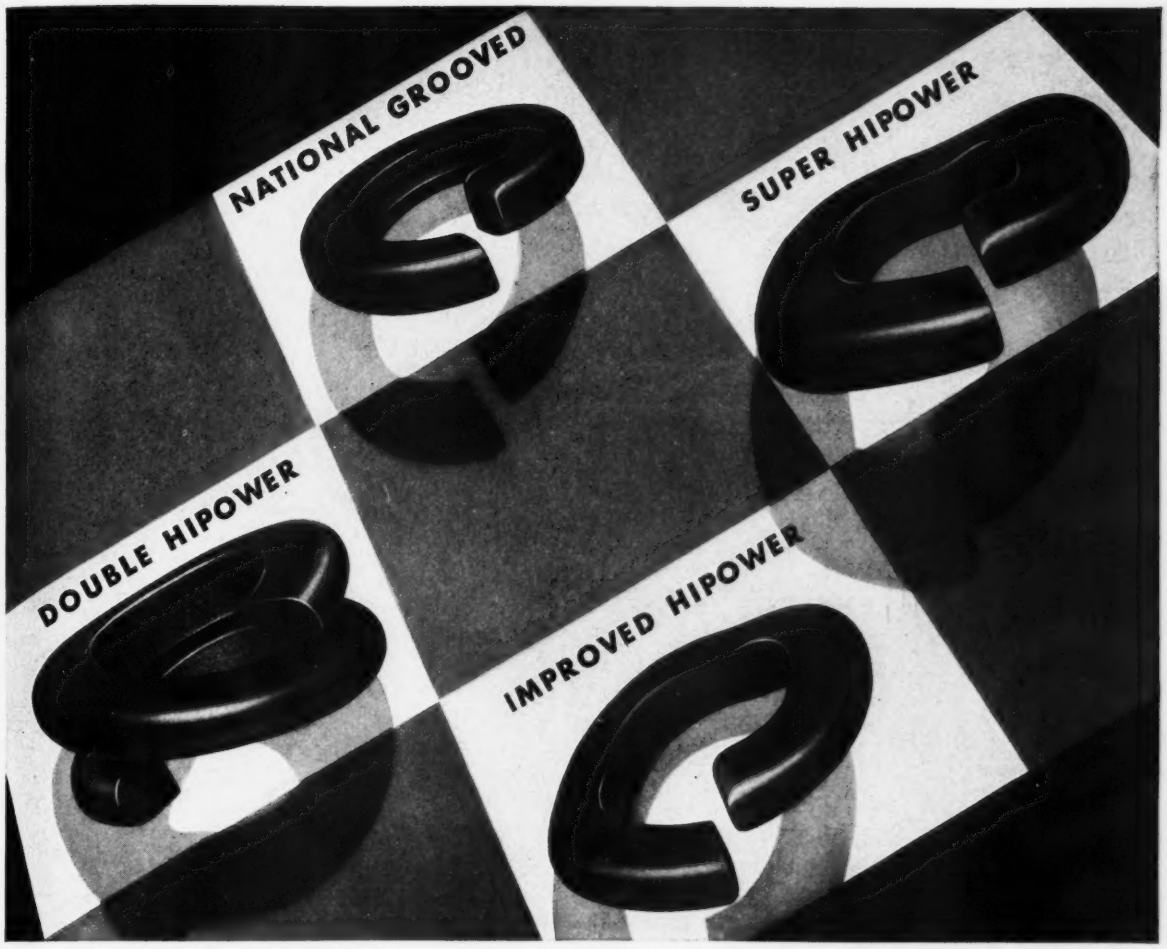

HIPOWERS

• The outstanding reputation of Hipower Spring Washers has been built up by tested performance on the great majority of railroads, large and small. • Hipowers have proved their efficiency by prolonging the life of rail and of the entire joint structure. They have reduced labor costs. They maintain efficient bolt tension, and at the same time allow the joint essential resiliency. • One road after another investigates, tests, equips, checks up and re-orders Hipowers,—that is why their prestige has grown. • For years our Hipower line, perfected by experience and research, has steadily built up a record and an established reputation of which we are justly proud. • We make spring washers for every track use.

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THE NATIONAL LOCK WASHER COMPANY

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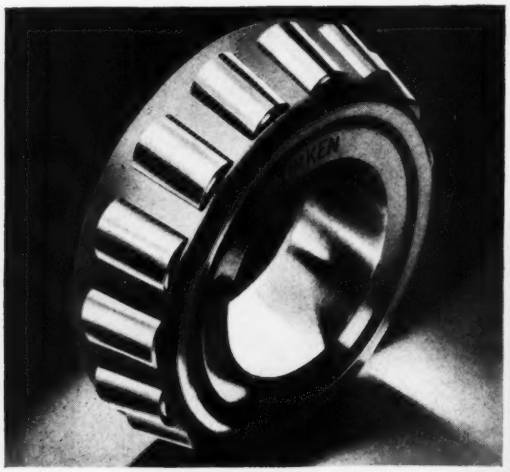
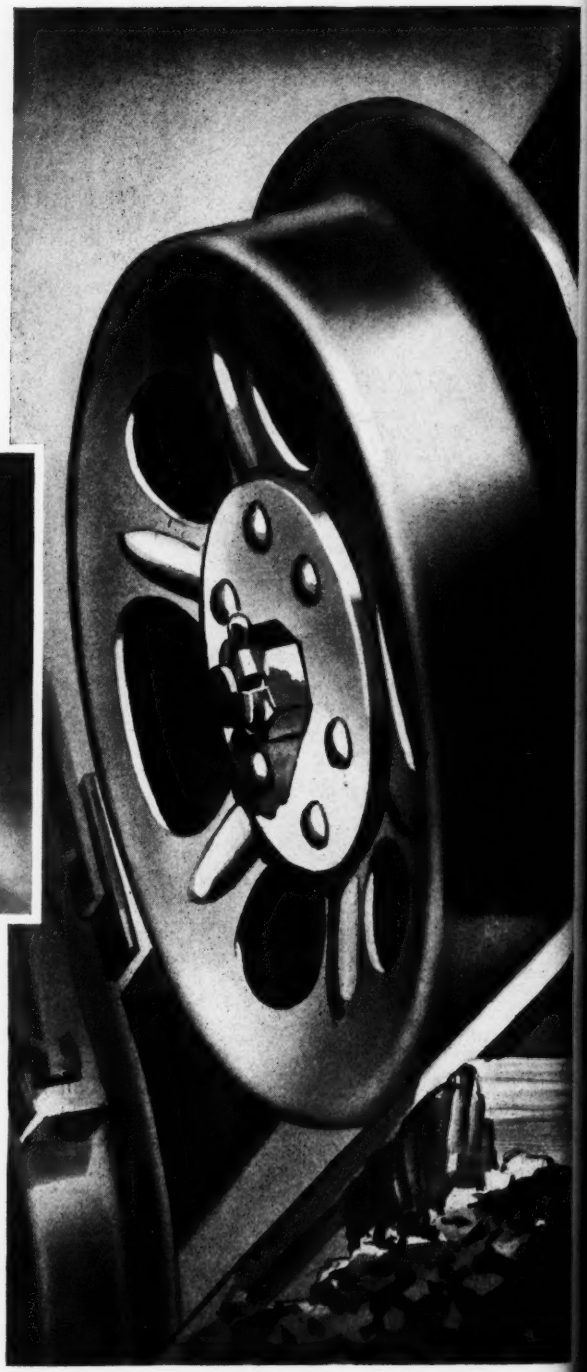
TIMKEN-equipped

Section Cars are Speedy, Safe, and . . Economical





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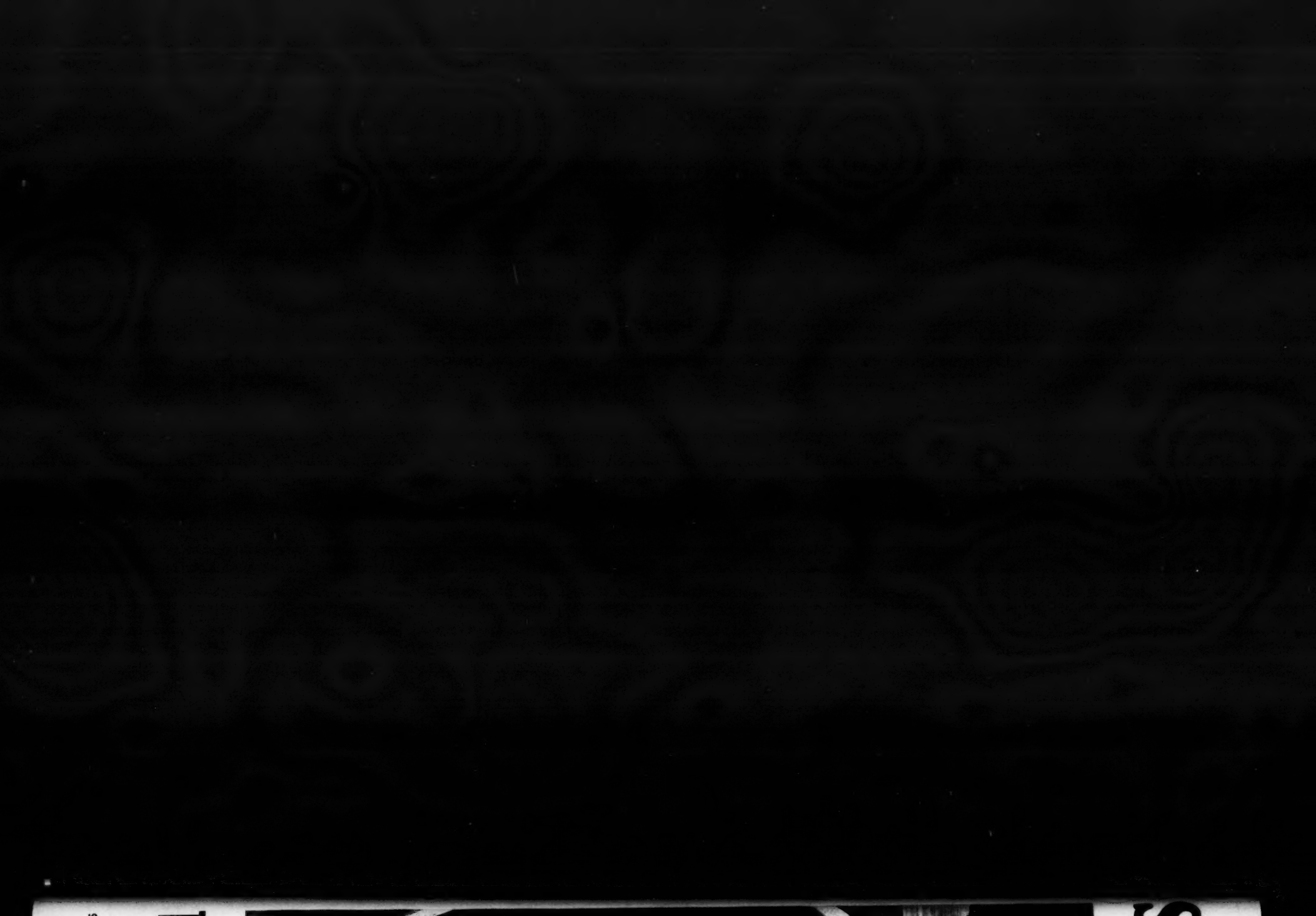
You have a wide range of choice when buying new cars. All the leading makes are Timken-equipped.

THE TIMKEN ROLLER BEARING CO. • CANTON, OHIO

TIMKEN TAPERED ROLLER BEARINGS